Performance Report on Surface Streets in the Seattle Central Business District

Volume 2: First Update - Post Tunnel Closure

January 31, 2006

As required by the Agreement between King County, City of Seattle and Sound Transit, as revised June 24, 2002, for the Downtown Seattle Transit Tunnel and Related Facilities.

Prepared by the Monitor and Maintain Committee, with representation from the following agencies:

City of Seattle
King County
SoundTransit
communitytransit
Pierce Transit

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Report Purpose

This report, and subsequent updates satisfies the requirements of Section 10.3 of the "Agreement Regarding the Design, Construction and Operation of the Downtown Seattle Transit Tunnel and Related Facilities", as executed by the City of Seattle, King County and Sound Transit.

Excerpts from Section 10.3 of this Agreement read as follows:

> "It is the Parties' intent that the Downtown Seattle Traffic and Street Improvements will be sufficient to maintain bus service performance on surface streets in downtown Seattle, during the closure period and after the tunnel is re-opened at performance levels similar to those existing prior to the Closure Period. The Parties hereby establish a Monitor and Maintain Committee (M&M Committee) to be comprised of the designated contacts set forth in Section 20.0. The M&M Committee may be expanded to include participation by other public agencies at the discretion of the Parties. The M&M Committee shall conduct baseline studies of bus travel time and passenger convenience, security, safety and comfort during a measurement period prior to the Closure Period (Baseline Measurement Period.)"
>
> "During the Closure Period and for one year after the Tunnel is reopened, the M&M Committee shall continue to monitor downtown Seattle transportation system performance and make recommendations to the Parties to take actions to maintain said system performance. In performing its functions, the Committee shall be directed to (a) consult with and seek input from suburban stakeholders and (b) report quarterly to the City Council's Transportation Committee regarding the performance of the downtown transportation system and regarding the Committee's consultation with various stakeholders."

The M&M Committee issued its first performance report in September, 2005 just prior to tunnel closure. Volume 1 of the report documented pre-tunnel closure conditions for six specific sets of performance measures. Data for this initial baseline report was collected during the spring and summer of 2005. The six sets of performance measures were as follows:

- Transit travel time
- General purpose traffic operations
- Transit ridership and bus volumes
- Pedestrian activity at bus zones
- Seattle Central Business District (CBD) customer surveys
- Transportation Demand Management (TDM) mitigation programs

This Volume 2 report includes three major elements. The first is an overall assessment of how the tunnel closure plan worked. The second is a detailed summary of the contingency planning effort that took place in the first 90 days following tunnel closure. Third, it compares the baseline data for the six sets of performance measures described above with data sets collected in the fall of 2005, following tunnel closure. Most of the post tunnel closure data included in this report was collected before the Thanksgiving holidays. This allowed for a better comparison before and after tunnel closure conditions in the Seattle central business district for non-holiday times.

The projected schedule for the release of the balance of the report updates is identified in Figure 1, as are the updated data sets that will be available with each of these reports. There will be eight reports issued in total over the next three and one half years. In March 2006 the M&M Committee will issue Volume 3, the third installment of this report.

Figure 1. Performance Report Release Dates

Performance Measure Updates	Performance Report Release Dates							
	Complete Sept 05 Volume 1	Complete Jan 06 Volume 2	March 06	July 06	Dec 06	June 07	Dec 07	Mar 08
Transit Travel Time	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
General Purpose Traffic Operations	⊙	⊙		⊙		⊙		⊙
Transit Ridership and Bus Volumes	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
Pedestrian Activity at Bus Zones	⊙	⊙	⊙				⊙	
Surveys of CBD customers	⊙	⊙		⊙	⊙	⊙	⊙	
TDM mitigation programs	⊙	⊙		⊙	⊙	⊙	⊙	⊙

The M&M Committee will use these reports to communicate on a regular basis the actions taken by the M&M Committee to address any deficiencies in the performance of the CBD transportation system during tunnel closure.

Executive Summary on Post Tunnel Closure Conditions

Volume 2 of this report summarizes the first three months of the post tunnel closure experience in the Seattle Central Business District, from September through November. Leading up to tunnel closure there was an intensive multi-agency effort to complete all five of the primary mitigation projects required to support tunnel closure. All five primary projects were complete and operational prior to tunnel closure. The projects were:

- Olive Way Transit Priority Improvements
- Third Avenue Peak Period Traffic Restrictions and Alternating Transit Stop Operation
- Ninth Avenue Transit Contra Flow Lane
- Prefontaine Place South Reconfiguration
- Fifth Avenue South Transit Contra Flow Lane

Going into the September service change, it was known that tunnel closure would directly impact over 60 percent of all transit riders to the Seattle Central business district, including all riders who previously used the tunnel. It was also known that travel patterns for general purpose traffic would be significantly altered.

Given the magnitude of these changes, the City of Seattle, King County and Sound Transit collaborated on an intense public outreach effort to inform all downtown users – transit riders, transit operators, employees, employers, businesses and property owners and drivers – of the upcoming changes. Yet, despite all advance preparations, there was still a high level of anxiety among downtown stakeholders over how the downtown system would actually operate once the tunnel closed.

Now, from a post tunnel closure vantage point, it can be reported that tunnel closure largely went as planned, and that there were no major system failures. The problems and issues encountered in the first week following the September service change were fairly typical of any major transit service change. Downtown stakeholders, including the Downtown Seattle Association, have remarked that the closure went smoothly, largely due to the agency partnership and strong communications with stakeholders, property owners and the general public. Agency staff continue to work individually with stakeholders to address specific issues.

On Tuesday September 27, 2005, the second commute day after the service change, *The Seattle Post Intelligencer* reported: “On the first day that 140 buses per hour bypassed the now-closed downtown transit tunnel onto surface streets, traffic did not turn chaotic. In fact, for the most part Monday, traffic moved smoothly downtown, though there was more of it. Many bus passengers, however, were confused over where their stops were, and some buses ran late.” This was typical of the media coverage during the first few days.

The multi-agency rider outreach program that accompanied tunnel closure provided an unprecedented level of staffing for “street teams” both to give advance notice of the changes and to assist riders once the service change took effect. By Wednesday, September 28, most riders had acclimated to the changes.

Immediately following tunnel closure, an interagency Contingency Planning/Quick Response team, composed of representatives from Sound Transit, King County Metro, City of Seattle, Community Transit and Pierce Transit was activated as part of the tunnel closure plan. This group actively monitored downtown traffic, transit operations and pedestrians, including locations that had previously been identified as areas that might have problems. This team closely coordinated their work with the Seattle Police Department and the King County Sherriff, particularly with respect to the enforcement of the new Third Avenue traffic restrictions and the enhanced bus stop security measures made possible by a special Bicycle Emphasis and Enforcement Squad, known as the “BEES”, which is assigned to the downtown core during tunnel closure.

The Quick Response staff team was charged with monitoring potential “hot spots”, with resolving any unanticipated problems to tunnel closure and with being responsive to concerns and suggestions from

downtown stakeholders. One of the major adjustments the Quick Response team dealt with post tunnel closure was an adjustment in the peak hour restrictions on Third Avenue in the evening rush hour from 3 -7 p.m. to 3 -6:30 p.m. Based on field observations and data from the transit monitoring system, it was determined that this 30 minute adjustment would not have a significant impact on bus operations and would help improve access to Third Avenue for downtown businesses and residents.

The other area of focus for the Contingency Planning/Quick Response teams has been the Stewart Street corridor. This corridor has experienced a significant increase in congestion and delay since tunnel closure. A series of additional improvements has been made to respond to these problems, with the most recent changes being implemented in January 2006. The Stewart corridor will be closely monitored over the next few months to determine if its performance has improved. These results will be available with the next update of this report (Volume 3, March 2006).

In addition to the Quick Response effort, there are six ongoing monitoring programs for the Seattle Central Business District. The six program elements that are being monitored throughout tunnel closure are:

- Transit travel time and reliability along key corridors
- General purpose traffic operations
- Transit ridership and bus volumes
- Pedestrian activity at major downtown bus zones
- Customer surveys of downtown stakeholders
- Transportation demand management program designed as mitigation for tunnel closure

Individual sections provide more detail on each of the elements listed above in the first reporting period post tunnel closure. Key highlights from each monitoring program are as follows:

<u>Transit Travel Time & Reliability</u>

Transit travel times were analyzed at a corridor level for multiple corridors in downtown. Results were also aggregated to provide an overall measure for the average transit travel time through downtown

For the aggregate measure, average transit travel time through downtown increased by 11 percent. This aggregate measure is a composite measurement of average time spent in the study area. This value is obtained by identifying the first and last observation of a bus trip in the CBD, regardless of the corridor. Averaging this figure for all trips results in a single value of time spent in the CBD for all observed trips. This value is used as an index, not a measure. This figure includes all time expended in the central business district, including layover time as well as time spent in service. It will also reflect many different paths through the CBD with different lengths and travel conditions. The measure becomes meaningful when compared to the same measure for future conditions to compare the ease of travel for transit through the CBD.

The baseline Travel Time Index is **100**, representing the surface street value before tunnel closure. The average pre-tunnel closure travel time value was 21:59 minutes, based on bus trips between 4-6 p.m. on weekdays during the month of July. The comparable number for post tunnel closure conditions in this report was 24:30 minutes. Therefore, the Travel Time index after tunnel closure is **111,** based on trips between 4 -6 p.m. during October and November. This represents an **11 percent** increase in time spent in the CBD.

The increase of 11 percent in the travel time index is due to two major factors. The first is the increased travel time and congestion on the Stewart and Virginia corridors. The second is the increased travel time required to support operating the former tunnel routes on surface streets. A comparison of the schedule time allocated to the route segments through the central business district corroborates this 11 percent increase in transit travel time in the Seattle central business district since tunnel closure. Between the June 2005 and September 2005 service change, there was an 11.8 percent increase in schedule time for

downtown routes. This increase was a planned mitigation measure and required an investment of approximately 45,000 annual hours of service, at an estimated annual cost of $4-5 million.

For the north-south transit corridors, transit travel time averages after tunnel closure were within one minute of the pre-closure baseline. On Third Avenue, conditions for transit improved noticeably. However, while the average travel time on these segments may not have the changed substantially, variability in transit travel times has increased since tunnel closure on some street segments, making service less reliable on a day to day basis. The area that has been most problematic for transit post tunnel closure is the east-west conditions on Stewart and Virginia. These segments performed significantly worse when compared to the baseline, both in terms of average travel time and day to day variance in schedules.

It much also be noted that all the routes that previously operated in the tunnel now experience much longer running times when compared to the eight minutes it took to travel from the International District station to the Convention Place station. The tunnel also offered a highly reliable trip. Surface operation for these former tunnel routes is both longer and considerably less predictable.

General Purpose Traffic Operations

Overall, travel times for general purpose traffic did not change significantly for the morning rush hour or for the midday period. Most of the changes were +/- 1 minute of the pre-tunnel closure times. However, travel in the evening rush hour is slower on several key corridors. Stewart Street and Fifth Avenue have been impacted the most, where trip times have increased by 2:31 and 1:45 minutes, respectively.

As expected, traffic volumes declined on Third Avenue and increased on other streets in the central business district due to the traffic restrictions on Third Avenue. The greatest traffic increases occurred on southbound Second Avenue south of Pine Street and on northbound Sixth Avenue south of Olive Street.

Because the data collected on general purpose traffic operations reflects only a sample of the days and times of travel, these results may not fully reflect that the downtown transportation system is now more fragile and more subject to periodic disruption due to various types of incidents, such as accidents, inclement weather, on-street parking violations, vehicle breakdowns and special events. There is very little reserve capacity left to deal with these situations. As a result, it takes less to trigger a traffic problem and longer for the system to recover from it.

Finally, a new Emergency Vehicle Signal Priority system was installed at forty locations throughout the Seattle central business district to mitigate potential impacts to the Seattle Fire Department response time due to tunnel closure. A new "Opticom" system was installed to replace the older system of fire preemption in which all the programmed signals on a corridor would change to either an all way red or hold in green for the fire response route for 180 seconds. This 180 second period created congestion and frustrated motorists. The new Opticom system is dynamic, and only the intersections that are within a few hundred feet of the approaching emergency vehicle are impacted. This minimizes the number of streets and intersections that have to recover from the emergency. Once the emergency vehicle has passed out of the line of sight, the signal goes into its recovery phasing and resynchronizes. This restores the response corridor back into its normal pattern in a timely manner rather than a set interval of 180 seconds.

Transit Ridership and Bus Volumes

Based on fall 2004 data, ridership at the downtown screen line at University Street was 95,000 riders on King County Metro-operated services. This number increased to 106,700 riders in the spring 2005 shakeup that immediately preceded tunnel closure. Based on partial data for the fall 2005 post tunnel closure (September through November), there has been a subsequent 1 percent growth in ridership at this screen line. Despite all of the changes in downtown transit services, King County Metro ridership at the screen line increased to 107,500. There are also ridership gains reported on the transit services from Pierce and Snohomish Counties to downtown Seattle.

Actual post tunnel closure bus volumes by street segment are generally consistent with the bus volumes that were projected in the baseline report. The changes that have occurred have been primarily associated with minor routing changes to reduce bus volumes on Stewart Street.

Pedestrian Activity at Bus Zones

The majority of bus stops functioned at an acceptable level of service both for waiting patrons and for those passing through the bus stop area.

Two zones, the northbound zone on Fourth Avenue at Union Street, and the eastbound zone on Olive at Sixth Avenue, experienced higher levels of congestion for patrons traversing the area. Fourth and Union problems were related to adjacent construction and should be resolved now that the construction is complete. The problems at Sixth and Olive are expected to continue, as there are few options for increasing the capacity of the sidewalk in this area.

For patrons waiting to catch the bus, the stop at Fifth Avenue and James Street experienced the most significant increase in pedestrian congestion. This may be related to schedule delays caused by Stewart Street. Further monitoring of this stop is planned.

Customer Surveys

A small intercept survey of approximately 200-300 downtown users was conducted in the fall of 2005 immediately following tunnel closure. The results of this survey can not be compared with the results of the much larger baseline survey conducted prior to tunnel closure. The type of inferences that can be drawn from the smaller intercept survey should be viewed as similar to the inferences that can be obtained from focus groups.

Based on the intercept survey, most respondents (62 percent) thought that getting downtown was about the same as it was before tunnel closure. But a sizable minority (31 percent) said getting downtown was more difficult.

The vast majority of respondents (93 percent) knew about tunnel closure before it happened and most of them (73 percent) recognized that there was a joint multi-agency effort to minimize the impacts of tunnel closure. People generally felt that the information supplied about tunnel closure was informative and most had heard about tunnel closure from more than one source.

There will be two additional small intercept surveys similar to the one described above, one in the spring of 2006 and the second in the spring of 2007. Additionally, there will be two more in depth customer survey conducted as part of this program, one in the summer of 2006 and the second in the summer of 2008 after the tunnel has reopened. These on depth surveys will have a much larger sample size and will be comparable to the baseline survey that was done prior to tunnel closure.

Transportation Demand Management Program

The Transportation Demand Management Program designed to support tunnel closure is a combination of new programs as well as enhancements to existing programs. Participation in all these alternative commute options has increased since tunnel closure.

Noteworthy statistics for this effort are: 30 new Flex Pass contracts accounting for 1,129 additional passes; 1,200 individuals served through the “Plan Your Commute” service; 500 additional registrations at Rideshare On Line; and the percentage of downtown employers offering telecommuting options increased from 10 percent to 22 percent.

Conclusions

In summary, the transit tunnel has been closed for more than three months. Even with the addition of 140 buses to surface streets during rush hour, downtown is still moving. This is due in large part to two years of careful planning, an investment of over $16 million in traffic improvements and effective agency partnerships to manage these changes. A lot of this success is also due to the Seattle Police Department, which has had the tough job of enforcing the new traffic restriction on Third Avenue.

Due to added traffic on some streets, the downtown street system does become congested more easily, and takes longer to recover from incidents such as on-street parking violations, accidents, or vehicle breakdowns. As expected, travel times on former tunnel routes is longer on the surface streets.

Post tunnel closure, developing additional mitigation measures to deal with problems on Stewart has been an area of emphasis. Metro, Sound Transit, and the City of Seattle will continue to monitor the downtown transportation system and work closely with downtown stakeholders through the balance of the tunnel closure period. These monitoring reports are an important tool for communicating the results of these efforts to all downtown stakeholders.

Summary of Contingency Planning Measures Post Tunnel Closure

Agencies prepared for the tunnel closure, developing a contingency plan. This included the identification of operational "hot spots" and potential actions to correct problems should they develop.

An interagency "Quick Response Team" was established with representatives from King County Transit, Sound Transit, City of Seattle, Community Transit, and Pierce Transit. This team of individuals had the responsibility and authority from each of the involved agencies to quickly respond and correct problems as they occurred.

Hot spots were identified as locations where there were existing operational or pedestrian constraints, or where enforcement might be needed due to projected increases in pedestrians, vehicles, or bus turning movements at certain intersections. Other areas in the downtown area were identified as "watch areas" and represented locations where there was the potential for minor operational issues to develop. The "Quick Response Team" designated key staff from Metro, City of Seattle Department of Transportation and Seattle Police as "agency implementers" to handle issues in real time as they arose.

Staff from the Quick Response Team were physically assigned to locations throughout the downtown core, during the morning and evening peak periods, to watch, evaluate, and determine if any corrective actions were needed. At the end of each AM and PM period, agency staffs met to debrief. The team evaluated the problems, identified and recommended solutions, and assigned staff to implement the desired changes. As these changes occurred, they were communicated by the partners to the downtown stakeholders and customers. The two weeks following tunnel closure was the most intense period of activity for these teams. Street level monitoring continues, but resources are now primarily focused on the areas that are known to need attention.

This section summarizes the key changes implemented by the Quick Response Team since tunnel closure. They fall into four general areas:

- Third Avenue, between Yesler and Virginia
- Stewart Street, between Second Avenue and Eighth Avenue
- Bus Stop/Security issues
- South Downtown

Third Avenue, between Yesler and Virginia

The implementation of Third Avenue general purpose traffic peak period restrictions and transit skip stop operations has been working quite well since its implementation During the first three weeks of the new traffic restrictions, the Seattle Police Department provided a high level of enforcement for general purpose vehicles and pedestrians. After the initial three-week period, the level of enforcement was reduced to a sustainable level and has been working well. The violation rate at the reduced level of enforcement does not significantly impact transit operations

On Third Avenue, staff evaluated the impact of reducing the evening restriction from 3-7 p.m. to 3-6:30 p.m. It was determined that this change could be made without seriously impacting bus travel times. This change went into effect on a trial basis beginning Monday, November 21, 2005. See the report section entitled "Measure 1: Transit Travel Time" for a summary of the analysis that was performed to support this decision.

Other adjustments to Third Avenue to ensure safe and efficient operations include:

- Additional training on skip stop operation was provided for transit operators.
- Signage changes were made to make peak hour traffic restrictions clearer.
- Adjustments to traffic signal timing were implemented.
- Additional communications with the public to troubleshoot problems educate the public about the service change and the new traffic restrictions.
- Lane widths were adjusted between Stewart and Pine to better accommodate buses.
- Bicycle "OK" stickers added to signs to allow bicycles in the curb lane.
- The commercial load zone on Third nearside Virginia was removed.

Stewart Street, between Second Avenue and Eighth Avenue

Transit and general traffic experienced increased congested and slow operating conditions on Stewart Street during the peak periods. Travel time through this corridor was also variable. The Quick Response team evaluated the problems along the Stewart corridor, and developed and implemented a multi-faceted solution to improve operations for both general purpose traffic and transit in this corridor. A chronology of the modifications are summarized below.

November 4, 2005:

- Three passenger load zones on Stewart between Seventh and Sixth restricted during peak periods (4-6 p.m. new restriction)
- Pedestrian signals installed at Stewart and Second in all directions

November 17, 2005:

- Parking restricted from 3-7 p.m. on north side of Stewart between Fifth and Fourth (7 stalls)
- Parking restricted during PM peak on south side of Stewart between Eighth and Seventh (2 stalls)

December 3, 2005

- Bus zone at Westlake and Fifth closed
- King County Metro routes 7E, 116, 118, 119, 196, and 202 relocated off of Stewart to reduce bus trips on Stewart (13 PM Peak Hour trips)
- A new skip stop pattern was implemented for certain routes on Stewart to reduce the number of buses making stops. In the PM peak hours, the number of buses stopping at Seventh Avenue was reduced by 21; the corresponding reductions on Fifth Avenue and Fourth Avenue were 17 buses and 9 buses, respectively.

Mid-January 2006

- Parking restricted during PM peak (3-7 p.m.) on south side of Stewart between Fifth and Fourth (10 stalls)
- Parking restricted during PM peak (3-7 p.m.) on south side of Stewart between Eighth and Seventh (5 additional stalls); 2 previous stall restrictions changed from 4-6 p.m. to 3-7 p.m.
- Parking restriction on Stewart between Seventh and Sixth changed from 4-6 p.m. to 3-7 p.m. (7 stalls); however, passenger load zone peak period restriction may be lifted to accommodate Max Hotel valet parking
- Extended bus zone on Virginia far side of Fifth Ave to the entire block and relocated Westin Hotel charter bus parking in consultation with the Westin.

February 11, 2006

- With its next service change, King County Metro will implement a set of schedule adjustment to improve on time performance on downtown service and to address overloads that have developed on selected trips. This will require an investment of approximately 4,000 annual hours.

Metro and SDOT will continue to monitor traffic operations on the Stewart Street corridor. Once all of the changes are in place and a concerted program of parking enforcement has been provided, it will be possible to measure the effectiveness of the entire package of modifications. The results of this analysis will be included in Volume 3, the next monitoring report.

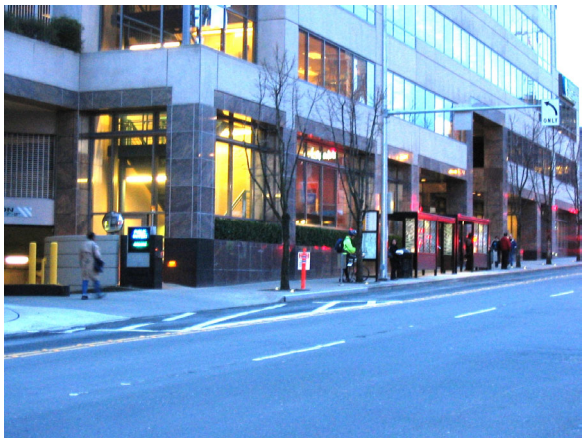
Bus Stop Issues

Siting bus stops in the downtown core is always challenging given the types of issues that come with high use bus zones in an urban area. Maintaining good relations with businesses and property owners adjacent to existing bus stops is an ongoing effort. There were two new bus stops that required a significant amount of attention to deal with property owner concerns. These were the stops at Third Avenue and Pike Street, adjacent to the Melbourne Tower, and at Ninth Avenue and Howell Street, adjacent to the Regence Blue Shield building. A summary of the actions that have been taken at these two zones is provided below.

Bus Stop at Third and Pike, adjacent to Melbourne Tower

- City Light has agreed to install two flood lights for improved visibility
- Seattle Police Department and Transit Security have made this zone a high priority for random patrols to address security issues.
- There are ongoing discussions with property manager about awning/leaning rail options to help draw people away from their entry.

Bus Stop at Ninth and Howell, adjacent to Regence Blue Shield



- Removed middle back panels from shelters for easier access to/from coaches
- Installed diagonal paint markings on pavement to help prevent blockage to/from the driveway.
- Metro Service Quality is performing several traffic checks to make sure operators do not block access to/from the driveway.
- The City of Seattle and Metro staff are evaluating the operation of the traffic signal at Ninth Avenue and Stewart Street to determine if queuing, which affect the driveway operation at the Regence building can be reduced.

South Downtown Area

- The primarily observation areas in south downtown area were Fifth Avenue between the intersection of Dearborn/Airport/Fifth Avenue and Washington Street, Washington Street between Fourth and Fifth Avenues and the new island platform on Fourth Avenue between S Jackson and Main Streets new skip stop pattern was implemented for certain routes on Stewart to reduce the number of buses making stops. In the PM peak hours, the number of buses stopping at Seventh Avenue was reduced by 21, the corresponding reductions at Fifth Avenue, and at Fourth Avenue were 17 buses and 9 buses, respectively.

Several signage, striping and signal timing adjustments were made in this area immediately after tunnel closure to address issues observed in the field.

The adjustments made in this area include the following:

- Additional green time was added to the northbound movement at signal at the intersection of Fifth and Washington.
- A westbound right turn lane was striped and signed on Jackson Street between Fifth and Fourth.
- Green time for the northbound phase was adjusted at the Fifth/Airport/Dearborn intersection.
- Loop detectors were repaired at the intersection of Royal Brougham and E3 Busway.
- A Seattle City Light pole was marked as hazard for buses on Fifth Avenue nearside of Main at new bus zone.
- The zone on Fifth Avenue far side of Jackson was extended by relocating a crosswalk.
- At the Fifth/Airport/Dearborn intersection, roadway markings were added for the south to eastbound right turn.
- A "Wait for Signal to Cross" sign was installed for pedestrians at the new bus platform on Jackson.

- Peak hour traffic restrictions were lifted on Washington Street between Fourth and Fifth Avenues.

Measure 1: Transit Travel Time

Monitoring Objectives

The purpose of monitoring transit travel times is to answer the following questions regarding transit travel times on surface streets in the Seattle Central Business District (CBD) before and after tunnel closure:

- How long are the transit travel times in the Seattle CBD?
- How consistent are the transit travel times in the Seattle CBD?
- Where are slowdowns occurring and are there mitigation measures that might address these slowdowns?

Methodology

Transit travel times were measured using roadside bus detection equipment at 16 locations in the Seattle CBD. The locations of these detection points are identified in Figure 2. A description of the equipment and technology can be found in the Methodology section of the baseline tunnel closure report.

The collection of transit travel times began in summer 2005 and will be continuously collected throughout the tunnel closure period. Two levels of data are included in the regular performance reports issued by the Monitor and Maintain Committee:

Level 1: Seattle CDB summary statistic is a high level summary of transit travel time for all bus movements. It consists of aggregated travel times through the study area to define an average transit operating time in the Seattle CBD for the AM peak and the PM peak. This measure will show the amount of time a bus takes on average to traverse the downtown area. Over time, this measure will identify the overall trend in the increase or decrease in delay caused by tunnel closure.

Level 2: Transit Corridor Travel Time summary will track travel time along specific transit corridors in the central business district. The transit corridors included in the monitoring are identified in Figure 2. The data will be categorized by corridor and by time of day (AM peak and PM peak). Variability of the data will also be reported to show the consistency of transit travel times.

Figure 2. Transit Travel Time Summary Analysis Corridors and Detection Point Locations

Transit Travel Time Comparison

Data of transit travel time post tunnel closure is collected continuously. For this report, weekday travel times between October, 2005 and November, 2005 were used. The first week after tunnel closure and the holiday season beginning Thanksgiving day are not considered to be comparable conditions to the before tunnel closure report data. Time of day periods, monitoring locations and analysis tiers are the same as the baseline report except where noted.

In general, transit travel time averages on surface streets after tunnel closure were within one minute of the pre-closure baseline on the north-south . On Third Avenue, conditions for transit improved noticeably; east-west travel times on Stewart and Virginia Streets were notably slower compared to the baseline. These conditions were identified soon after tunnel closure and additional mitigation actions were taken. The additional mitigation will be assessed after they are completely implemented, and the effectiveness of these measures will be reported in the next report.

Seattle CBD Travel Time Summary (Level 1):

The first level of analysis for downtown transit travel time is a composite measurement of average time spent in the study area on surface streets. This value is obtained by identifying the first and last observation of a bus trip in the CBD, regardless of the corridor. Averaging this figure for all trips results in a single value of time spent in the CBD for all observed trips.

This value is used as an index, not a measure. This figure includes all time expended in the central business district including layover time as well as all time spent in service. It also reflects many different paths through the CBD with different lengths and travel conditions. The measure becomes meaningful when compared to the same measurement in the future to compare the ease of travel for transit through the CBD.

The baseline Travel Time Index is **100**, representing the value before tunnel closure. The average travel time value for transit routes operating on surface streets was 21:59 minutes, based on bus trips between 4-6 p.m. on weekdays during the month of July. The Travel Time index after tunnel closure is **111** based on trips between 4-6 p.m. during October and November. This represents an **11 percent** increase in time spent in the CBD on surface streets. Most of the increase can be attributed to the increased travel times on Stewart and Virginia Streets, and the additional time required to operate tunnel routes on surface streets. A comparison of the schedule time allocated to route segments in the CBD corroborates this 11perecent increase in travel time. Between the June 2005 and September 2005 service changes, there was an 11.8 percent increase in scheduled time for downtown routes. This increase was a planned mitigation measure and required an investment of approximately 45,000 annual hours of service, at an estimated annual cost of $4.5 million.

Transit Corridor Travel Time Summaries (Level 2)

The four charts in Figure 3 show the average travel times for transit on selected segments of the surface streets in the CBD after tunnel closure. The data was collected in October and November of 2005 using the monitoring system. The data used is from weekdays only, and does not include data from during or after the Thanksgiving holiday. Each chart shows the average travel time for the direction of travel and time of day indicated. The AM charts include buses observed between 7 - 9 a.m. at the first reader on the corridor being measured. The PM charts cover the time period from 4 -6 p.m..

The corridor average travel times are compared to the comparable baseline measurements. Corridor travel times should not be compared to each other. Readers were placed to ensure route coverage. Readers were also sited to facilitate communications and insure access to power. As a result, the measured corridors differ in length, number of stops and number of signals, all of which affect travel time but are not related to congestion. The corridor boundaries and baseline and after closure measurements are described below.

The reader locations that define the boundaries of each of the transit corridors are described below along with a table for each corridor that summarizes the Average Travel Time by time period along with the standard deviation (SD) of the observations in minutes. As a statistical measure, approximately 69 percent

of all observations are within one standard deviation of the average. The SD can be interpreted as approximating the range (+/- SD) of the typical travel time that a majority of bus riders will experience on the corridor.

Figure 3. Transit Corridor Travel Time Before and After Tunnel Closure

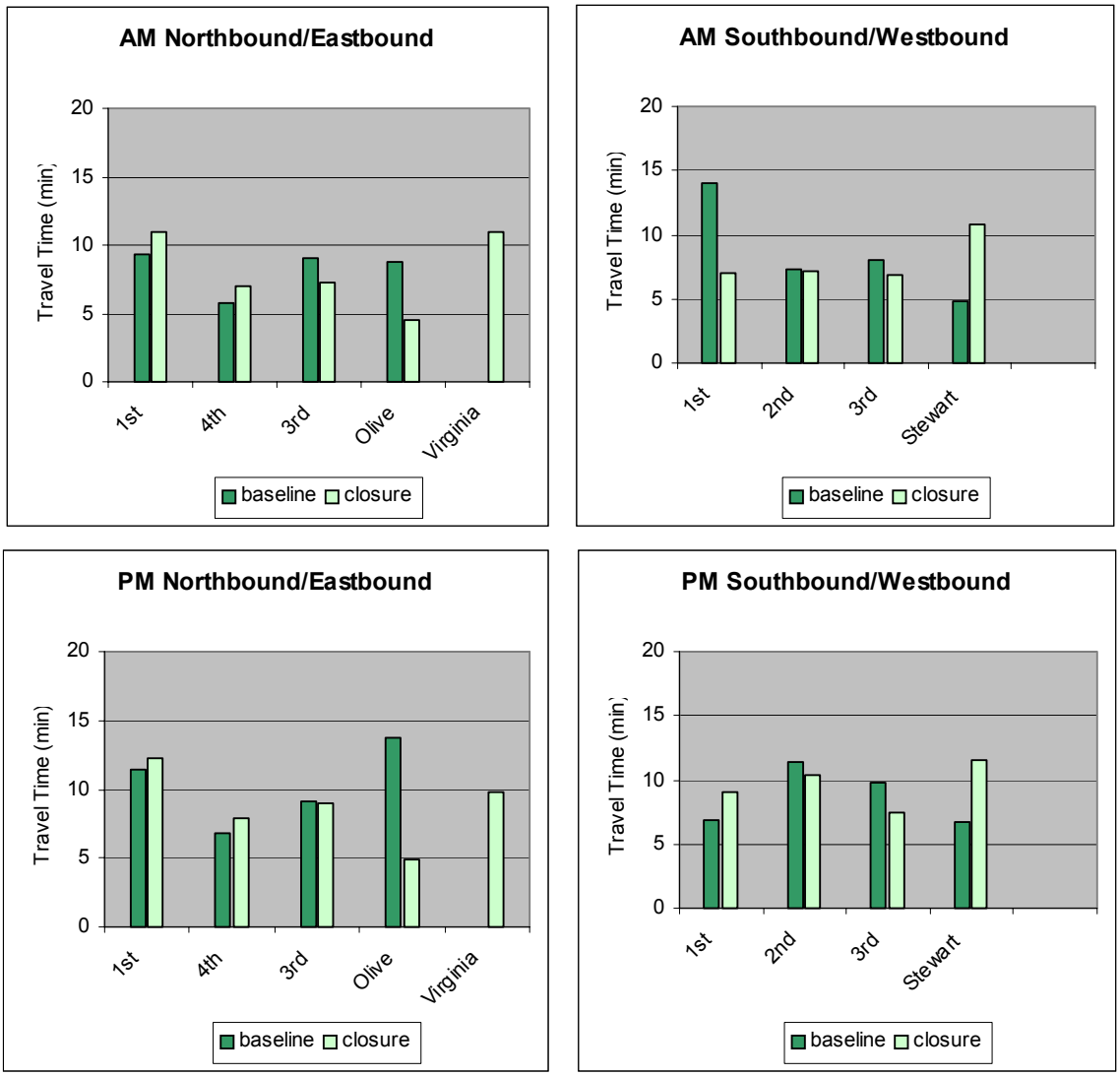


Figure 4A. First Avenue Transit Travel Time and Variation

First Avenue	**AM Peak (7 – 9 a.m.)**	**PM Peak (4 – 6 p.m.)**
Northbound, Royal Brougham to Seneca Street	Travel time: Baseline: 9 min 22 sec *(SD: 4.8 min)* Closure : 10 min 54 sec *(SD: 5.8 min)* *Change : +1min 32 sec*	Travel Time: Baseline : 11 min 24 sec *(SD: 5.3 min)* Closure : 12 min 12 sec *(SD:6.0 min)* *Change : +48 sec*
Southbound, Seneca Street to Royal Brougham[1]	Travel time: Baseline: 14 min *(SD: 8.8 min)* Closure : 7 min *(SD: 5.4 min)* *Change : -7min*	Travel time: Baseline : 6 min 51 sec *(SD: 3.9 min)* Closure : 9 min 6 sec *(SD: 6 min)* *Change : +2 min 15 sec***

[1] *The comparison of baseline data with post tunnel closure data for on First Avenue shows a significant change in southbound travel time in the AM period. However, the baseline averages were based on relatively few observations and may not be accurate due to a small sample size. Closure data is based on*

many more observations, and is more accurate. Given the change in the northbound direction, southbound travel times in both directions are most likely one to two minutes slower than before tunnel closure.

First Avenue (Northbound and Southbound) reader locations are Royal Brougham to the south and Stewart Street to the north, with a midpoint at Seneca Street. The initial travel time measurements are for the segment between Seneca Street and Royal Brougham only because of delays in powering the Stewart Street reader. For consistency, the closure data measures the same start and end points as the baseline report. Future reports will transition to the full corridor definition.

Figure 4B. Second Avenue Transit Travel Time and Variation

Second Avenue	**AM Peak (7– 9 a.m.)**	**PM Peak (4– 6 p.m.)**
Southbound, Pike Street to S Jackson Street	Travel time: Baseline : 7 min 20 sec *(SD: 1.9 min)* Closure : 7 min 13 sec *(SD: 2.6 min)* *Change : - 7 sec*	Travel time: Baseline : 11 min 26 sec *(SD: 4.3 min)* Closure : 10 min 26 sec *(SD: 3.5 min)* *Change : -1min*

Second Avenue (Southbound only) reader locations are Pike Street and S Jackson Street with a midpoint at Seneca Street. Second Avenue maintained the same average travel time with slightly more variation in the AM peak. In the PM peak, average travel times improved by one minute in average and variation. The PM peak improvements could be attributed to the end of the baseball season and the slight reduction of transit trips during the peak.

Figure 4C. Third Avenue Transit Travel Time and Variation

Third Avenue	**AM Peak (7– 9 a.m.)**	**PM Peak (4 – 6 p.m.)**
Northbound, Yesler Way to Stewart Street*	Travel time: Baseline : 9 min *(SD: 4.6 min)* Closure : 7 min 20 sec *(SD: 3.1 min)* *Change : -1min 40 sec*	Travel Time: Baseline : 9 min 6 sec *(SD: not available)* Closure : 8 min 57 sec *(SD: 3.6 min)* *Change : - 9 sec*
Southbound, Stewart Street to Yesler Way	Travel time: Baseline : 8 min 5 sec *(SD: 1.3 min)* Closure : 6 min 52 sec *(SD: 2.8 min)* *Change : -1min 12sec*	Travel time: Baseline : 9 min 45 sec *(SD: 2.5 min)* Closure : 7 min 27 sec *(SD: 2.9 min)* *Change : -2min 18sec*

Third Avenue (Northbound and Southbound) reader locations are Stewart Street to the north, and Yesler Way to the south, with a midpoint at Seneca Street. Average travel times improved in both directions and in both peak periods after tunnel closure due to traffic restrictions and transit lanes implemented on the corridor.

In addition, a special travel time study of Third Avenue was conducted in November, 2005 to assess the impact of reducing the hours of peak restrictions by 30 minutes to start at 6:30 a.m., rather than 6 a.m. and to end at 6:30 p.m., rather than 7 p.m.. It was determined that the proposed change in AM peak restrictions would be detrimental to transit, particularly given the increase in bus volumes along Third Avenue that take place in this 30 minute period. However, the change in the PM restrictions was judged to be acceptable. No impact was projected and once the reduced PM restrictions were implemented on November 21, 2005, no negative impacts were observed. This is due to the significantly lower volumes of buses and general traffic in the 30 minute period between 6:30-7 p.m.

Figure 4D. Fourth Avenue Transit Travel Time and Variation

Fourth Avenue	**AM Peak (7– 9 a.m.)**	**PM Peak (4 – 6 p.m.)**
Northbound, S Jackson Street to Seneca Street	Travel time: Baseline : 5 min 48 sec *(SD: 1.2 min)* Closure : 6 min 58 sec *(SD: 2.8 min)* *Change : +1min 10 sec*	Travel Time: Baseline : 6 min 46 sec *(SD: 1.1 min)* Closure : 7 min 50 sec *(SD: 4 min)* *Change : +1min 4 sec*

Fourth Avenue (Northbound only) reader locations are Seneca Street to the north and S Jackson Street to the south. Average travel times increased by one minute during both the morning and evening peak periods, with notably more variation.

As noted above, there have been minimal changes in peak hour transit travel time on the north-south surface streets. However, the routes that previously operated in the tunnel now experience much longer running times when compared to the eight minutes it formerly took them to travel from the International District station to the Convention Place station via the tunnel. Depending on routing, time of day and direction of travel, trips through the central business district on former tunnel routes can takes 14 to 23 minutes longer. The tunnel also offered a highly reliable trip. Surface operation for these former tunnel routes is both longer and considerably less predictable.

Figure 4E. Olive Way and Virginia Ave Transit Travel Time and Variation

	AM Peak (7 – 9 a.m.)	**PM Peak (4 – 6 p.m.)**
Eastbound Virginia, Third Avenue to Ninth Ave	Travel time: Closure : 10 min 39 sec *(SD: 5.1 min)*	Travel Time: Closure : 9 min 50 sec *(SD: 4.9 min)*
Eastbound Olive Way, Third Avenue to Eighth Ave	Travel time: Baseline : 8 min 42 sec *(SD: 9.1 min)* Closure : 4 min 34 sec *(SD: 2.4 min)* *Change : -4min 8 sec*	Travel Time: Baseline : 13 min 43 sec *(SD: 9.7 min)* Closure : 4 min 51 sec *(SD: 2.5 min)* *Change : -8min 52 sec*
Eastbound Howell, Eighth Ave to Yale Street	Travel time: Baseline : 2 min 6 sec *(SD: 1.4 min)* Closure : 3 min 53 sec *(SD: 2.4 min)* *Change : +1min 47 sec*	Travel Time: Baseline : 5 min 25 sec *(SD: 3.1 min)* Closure : 5 min 37 sec *(SD: 3.3 min)* *Change : +12 sec*

Virginia Street (Eastbound only) reader locations are Third Avenue at Stewart to the west and Ninth Avenue at Stewart to the east. Virginia Street was not a transit routing before the tunnel closure, so there is no baseline data. This corridor is two blocks longer than the parallel Olive Way with an additional turn. However, compared with baseline data for Olive, Virginia is slower in the AM peak but faster, with less variability in the PM peak.

Olive Way (Eastbound only) reader locations are Third Avenue to the west and Eighth Avenue to the east. Average travel times decreased dramatically on Olive Way between Third and Eighth Avenues. Travel time variation improved as well.

Howell (Eastbound only): Transit on Howell east of Eighth Avenue slowed in the AM but was still more than a minute faster than the PM average which stayed even after tunnel closure.

Figure 4F. Stewart Street Transit Travel Time and Variation

	AM Peak (7 – 9 a.m.)	**PM Peak (4– 6 p.m.)**
Westbound, Ninth Avenue to Third Avenue	Travel time: Baseline : 4 min 50 sec *(SD: 1.9 min)* Closure : 10 min 52 sec *(SD: 5.2 min)* *Change : +6min 2 sec*	Travel Time: Baseline : 6 min 42 sec *(SD: 1.5 min)* Closure : 11 min 36 sec *(SD: 4.9 min)* *Change : +4min 54 sec*

Stewart Street (Westbound only) reader locations are Third Avenue to the west and Ninth Avenue to the east. Average travel time on Stewart Street approximately doubled increasing 6 minutes in the AM peak, and 5 minutes in the PM peak. Variation also increased dramatically. The baseline data on this corridor was a different data source due to equipment difficulties, but the results are consistent with field observations comparing before and after conditions.

Measure 2: General Purpose Traffic Operations

Monitoring Objectives

The purpose of monitoring general purpose traffic operations is to measure the impacts of tunnel closure on general purpose traffic in the following areas:

- Measure the change in general purpose traffic volumes
- Measure the change in general purpose travel times
- Review traffic operations in the Seattle CBD and make revisions as needed

Methodology

Three data collection efforts were used to evaluate the effect that tunnel closure has had on CBD traffic operations: tube counts; travel time studies; and turning movement counts. Traffic counts using pneumatic tubes were employed to collect traffic volumes at selected locations throughout the Seattle CBD. These automated counting machines yield hourly and daily directional volumes. Travel time studies were also conducted to quantitatively assess changes in travel time for general traffic on several corridor segments before and after the tunnel closure. These corridors included segments along First Avenue, Second Avenue, Fourth Avenue, Fifth Avenue, Stewart Street, Olive Way, Pike Street, Spring Street and Cherry Street. Turning movement counts were also collected at 23 locations. The pre-tunnel closure data was collected in January 2005. The first installment of post tunnel closure data was collected in October, 2005.

Travel time runs were used to estimate changes in general purpose travel time due to the general purpose travel restriction placed on Third Avenue. The "floating car" travel time method was used to collect this data. This method consists of probe cars driven along the routes, where the driver records the time it takes to traverse the route moving within the flow of general traffic. See Figures 5A, 5B, and 5C for a comparison of each of the twelve distinct travel paths, illustrated by time of day.

Figure 6 provides a comparison of pre- and post-tunnel closure PM peak hour volumes and Average Weekday Daily traffic (AWDT).

Figure 6 is a table illustrating changes in vehicle turning movements for the PM peak hour for each of the study locations. The figure highlights turning movement volumes that changed by more than +/-15 percent from pre- to post tunnel conditions, and where the total change in volume was over 100 vehicles per hour. For example, a change in traffic volume from 25 to 50 vehicles an hour is of little significance, but would reflect a 100 percent increase in volume.

Traffic Analysis

With the implementation of the traffic revisions instituted as tunnel closure mitigation, it was anticipated that traffic circulation and travel through town would be impacted. The overall effectiveness of these traffic mitigation strategies could only be proven through actual operating experience and this led to some concern that travel might be difficult in the central business district during this two year closure period.

Based on the first set of post tunnel closure traffic statistics, travel in the morning peak and off-peak periods has been mitigated adequately in terms of sustaining pre-tunnel closure travel times in all but a few cases. During the PM peak period, there are some areas that have experienced increases in travel times.

General Note: Travel time summaries are based on a limited number of observations. A range of 4 to 15 observations does not constitute a statistical sample. However, observations that will be made in future studies should refine and strengthen the value of these reported measures.

The following is a summary of the key findings for general purpose vehicle travel in the Seattle Central Business district following tunnel closure:

Travel Time for General Purpose Traffic:

AM Peak Period (7 - 9 a.m.)

Southbound from Third Avenue and Washington Street to Fourth Avenue and Royal Brougham increased by almost 1 minute.

Olive from Third Avenue to Boren improved by over 1:18 minutes, a possible result of the signal timing changes and transit lane investment.

Pike Street travel time improved by nearly 1 minute.

All other travel times during the a.m. period were less than 1 minute difference, and represent no significant change in operation.

Midday Period (1 -3 p.m.)

Cherry Street travel time increased by 1:40 minutes based on a sample of 6 travel time runs – this will be monitored to see if any action is required. Construction of a high rise in the area may have contributed to these results.

Pike Street improved by nearly 1 minute.

All other travel times during the midday period were less than 1 minute difference, and represent no significant change in operation.

PM Peak Period (4 -6 p.m.)

Stewart Street travel times increased the most –from 3:44 to 6:15 minutes for a total of 2:31 minutes. This is attributed to the increased volumes of both bus and general purpose traffic on Stewart and to additional turning traffic from Stewart to Second Avenue. Several actions have been taken to address this issue. These measures include additional curb use restrictions, transit re-routes, signal timing changes, and the upgrade of signal equipment. This is being closely monitored to determine if additional treatments will be required.

Second Avenue travel time has increased by over 1 minute due to increased congestion between Stewart and Spring Streets.

Fifth Avenue travel times increased from 4:46 to 6:28 minutes, an additional 1:45 minutes.

Spring Street travel time increased by approximately 1 minute.

All other travel times during the p.m. period were less than 1 minute difference, and represent no significant change in operation.

Traffic Volumes

PM Peak Period (4 -6 p.m.)

Ranking based on increased volume

Southbound volume on Second Avenue north of Pine Street increased by 207 vph (+18 percent).

Northbound volume on Sixth Avenue south of Olive Way increased by of 199 vph (+19 percent).

Northbound volume on Sixth Avenue south of University St. increased by 168 vph (+16 percent).

Northbound volume on First Avenue south of Seneca increased by of 98 vph (+14 percent).

Westbound volume on Stewart east of Second Avenue increased by of 97 vph (+16 percent).

Volumes dropped an average of 65 percent on Third Avenue.

AWDT (Average Weekday Daily Traffic)

Third Avenue volumes dropped on average 21 percent of pre-tunnel volumes.

Third Avenue daily volumes drop on average by 1,130 vehicles per day. The range was between 600 to 2,000 vehicles per day depending on location.

Southbound Second Avenue volumes north of Pine St increased the most of all locations. The increase was 3,128 vehicles per day (+22 percent of pre-tunnel AWDT).

Westbound Stewart Street volumes east of Second increased by 1,188 vpd, or +17 percent of pre-tunnel AWDT.

Northbound Sixth Avenue also experienced an increase in daily traffic with up to an additional 2000 daily trips as measured south of Olive Way, or +16 percent increase.

Fourth Avenue experienced an increase in AWDT of +6 percent of pre-tunnel volumes in the northbound one-way section between James and Union Streets.

Turning Movement Counts

Some of the largest increases in turning movement counts were the northbound through movement along Fourth Avenue with over 500 vph in the morning near Cherry Street, and 500 vph northbound in the afternoon near Union Street. This diversion from Third to Fourth Avenues was anticipated, and this illustrates the effect of multiple high rise building garages in the between Cherry and Union Streets area.

Only two of the measured turning movements (actual turns) experienced an increase of more than 100 vph. These are the southbound right turn at Stewart Street and Third Avenue, and the southbound left turn at Spring and Second Avenue. Third and Stewart experience an additional 123 vph during the PM peak hour. Second Avenue and Spring Street had 106 additional turns during the AM peak period.

Some traffic appears to be avoiding Stewart Street and favoring westbound Lenora Street as an alternate route with an additional 97 trips in the a.m. and 160 trips in the PM peak hours.

Figure 5A. General Purpose Travel Time AM Peak (7– 9 a.m.)

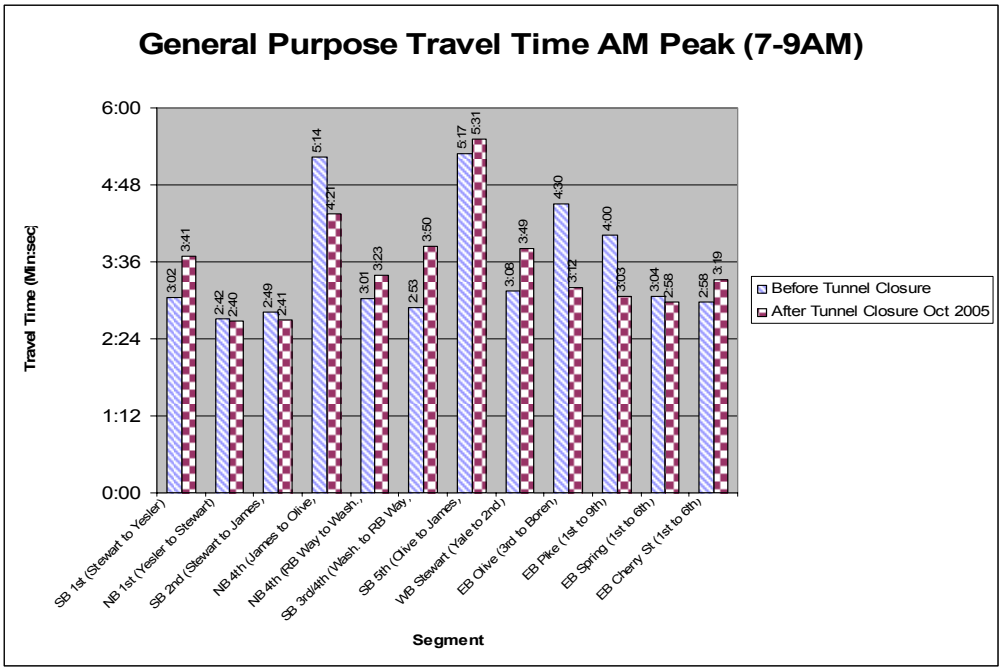


Figure 5B. General Purpose Travel Time PM Peak (4 - 6 p.m.)

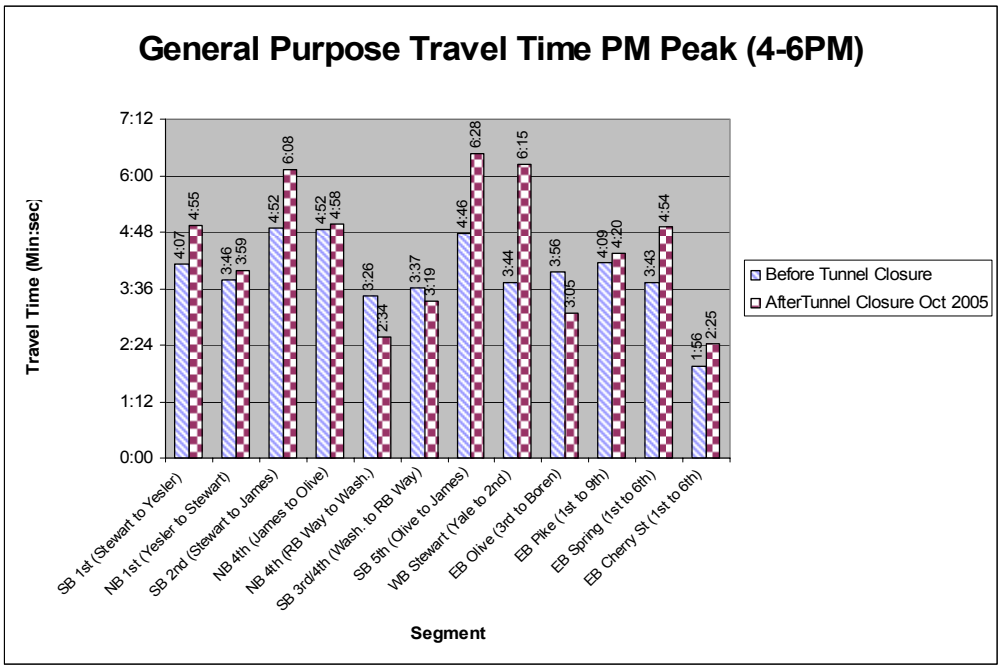


Figure 5C. General Purpose Travel Time Off-Peak (1-3 p.m.)

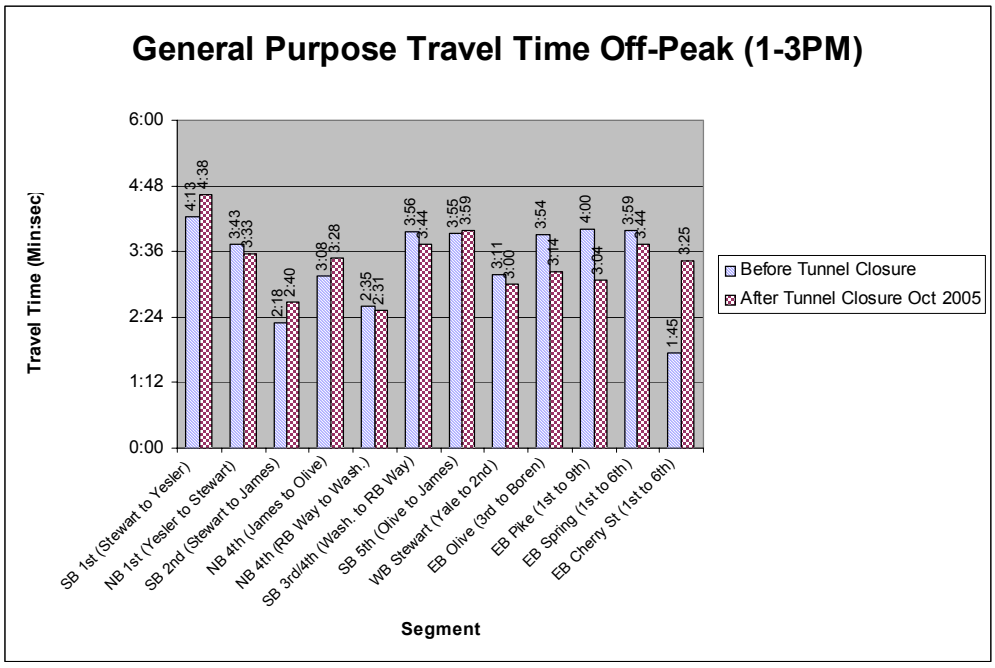


Figure 6. Changes in AWDT Volumes

		Jan-05 Pre-Tunnel Closure		Oct-05 Post Tunnel Closure			
LOCATION	**DIR FLOW**	**PM PK**	**AWDT**	**PM PK**	**AWDT**	**Percent Change Peak Hour**	**Percent Change AWDT**
1ST AVE, NW/O CHERRY ST	South	610	6,645	436	6,467	-29%	-3%
1ST AVE, NW/O SPRING ST	South	797	10,211	790	10,123	-1%	-1%
2ND AVE, NW/O PIKE ST	South	1,339	16,831	1,232	15,333	-8%	-9%
2ND AVE, NW/O PINE ST	South	1,174	14,441	1,381	17,569	18%	22%
2ND AVE, NW/O VIRGINIA ST	South	1,038	12,429	990	13,013	-5%	5%
3RD AVE, NW/O LENORA ST	South	316	3,749	228	3,131	-28%	-16%
3RD AVE, NW/O PINE ST	South	447	4,684	296	3,612	-34%	-23%
3RD AVE, NW/O STEWART ST	South	356	4,095	260	3,331	-27%	-19%
3RD AVE, NW/O VIRGINIA ST	South	376	4,450	259	3,473	-31%	-22%
3RD AVE, SE/O JAMES ST	South	459	4,286	260	3,132	-43%	-27%
3RD AVE, SE/O UNION ST	South	478	6,297	358	4,282	-25%	-32%
5TH AVE S, N/O S JACKSON ST	South	600	5,626	640	6,497	7%	15%
5TH AVE S, N/O S MAIN ST	South	561	5,590	572	6,171	2%	10%
5TH AVE S, S/O S WELLER ST	South	611	5,094	583	5,670	-5%	11%
WESTERN AVE, NW/O YESLER	South	262	2,301	256	2,304	-2%	0%
1ST AVE, SE/O COLUMBIA ST	North	550	7,430	593	7,968	8%	7%
1ST AVE, SE/O SENECA ST	North	677	7,661	775	8,403	14%	10%
3RD AVE, SE/O BLANCHARD ST	North	630	5,358	338	4,091	-46%	-24%
3RD AVE, SE/O JAMES ST	North	405	4,871	341	4,275	-16%	-12%
3RD AVE, SE/O LENORA ST	North	692	6,189	391	4,829	-44%	-22%
3RD AVE, SE/O STEWART ST	North	692	6,667	396	5,550	-43%	-17%
3RD AVE, SE/O UNION ST	North	515	6,164	359	4,690	-30%	-24%
3RD AVE, SE/O VIRGINIA ST	North	655	5,901	335	4,751	-49%	-19%
4TH AVE S, S/O S JACKSON ST	North	1,218	13,926	1,041	12,068	-15%	-13%
4TH AVE, SE/O CHERRY ST	North	1,784	18,833	1,820	19,000	2%	1%
4TH AVE, SE/O JAMES ST	North	1,523	15,698	1,554	16,456	2%	5%
4TH AVE, SE/O UNION ST	North	1,808	19,236	1,900	20,383	5%	6%
5TH AVE S, S/O S WELLER ST	North	86	1,144	155	1,814	81%	59%
6TH AVE, SE/O OLIVE WAY	North	1,055	12,618	1,254	14,644	19%	16%
6TH AVE, SE/O UNIVERSITY ST	North	1,026	15,102	1,194	16,332	16%	8%
WESTERN AVE, SE/O COLUMBIA	North	208	1,587	211	1,637	1%	3%
CHERRY ST, SW/O 3RD AVE	East	548	5,100	547	5,255	0%	3%
JAMES ST, SW/O 3RD AVE	East	313	2,759	363	3,115	16%	13%
SPRING ST, SW/O 3RD AVE	East	747	7,885	721	7,814	-3%	-1%
UNIVERSITY ST, SW/O 3RD AVE	East	445	5,626	507	6,508	14%	16%
JAMES ST, NE/O 2ND AVE	West	282	4,049	290	4,002	3%	-1%
LENORA ST, NE/O 2ND AVE	West	440	4,463	404	4,620	-8%	4%
PINE ST, NE/O 2ND AVE	West	424	5,330	410	5,602	-3%	5%
STEWART ST, NE/O 2ND AVE	West	626	7,191	723	8,379	16%	17%
STEWART ST, NE/O 4TH AVE	West	785	10,869	819	11,756	4%	8%

AWDT = Average Weekday Traffic count in vehicles per day
PMPK = PM peak hour traffic count in vehicles per hour

Figure 7. Percent change in traffic turning movement volumes between pre- and post-tunnel closure conditions

Intersection	Time Period	NB Left	NB Thru	NB Right	SB Left	SB Thru	SB Right	EB Left	EB Thru	EB Right	WB Left	WB Thru	WB Right
Fifth Avenue	AM				-22%	41%	131%		86%	56%	-60%	71%	
Main St	MD				-9%	30%	-25%		4%	71%	-17%	13%	
	PM				43%	-11%	28%		23%	38%	-13%	90%	
Fourth	AM		*-13%*	-21%				8%	-9%			11%	-1%
S Jackson St	MD		6%	-30%				0%	5%			34%	4%
	PM		-7%	-21%				-2%	-4%			22%	-13%
Fifth Avenue	AM				-20%	15%	0%		-65%	-17%	-31%	-51%	
S Washington	MD				43%	27%	46%		-6%	4%	0%	15%	
	PM				-18%	-1%	-27%		63%	56%	-53%	-47%	
Fourth	AM	84%	*13%*	24%				60%	3%			-17%	20%
James St	MD	25%	2%	-7%				140%	11%			-3%	-12%
	PM	60%	*13%*	-25%				80%	33%			0%	3%
Fourth	AM		41%	60%				58%	2%				
Cherry St	MD		*13%*	20%				-22%	-1%				
	PM		*11%*	12%				21%	-7%				
Fourth	AM	15%	*14%*									3%	22%
Union St	MD	6%	10%									0%	-4%
	PM	29%	40%									-8%	10%
Sixth Avenue	AM		*-11%*	-15%				18%	-25%				14%
University St	MD		6%	-7%				14%	-8%				-4%
	PM		20%	-6%				25%	-5%				113%
Sixth Avenue	AM		2%	0%				-21%	33%				
Olive Way	MD		-10%	9%				-20%	-2%				
	PM		12%	16%				26%	37%				
Second	AM				11%	5%	-14%		-5%	-21%	-24%	-10%	
James St	MD				18%	3%	15%		31%	33%	6%	18%	
	PM				19%	-7%	-23%		22%	-9%	-6%	36%	
Second	AM				23%	12%			1%	0%			
Cherry St	MD				9%	20%			12%	29%			
	PM				-15%	*10%*			-14%	-31%			
Second	AM				47%	20%			5%	21%			
Spring St	MD				7%	20%			-3%	7%			
	PM				20%	*13%*			11%	-2%			
Second	AM				28%	19%			1%	6%			
University St	MD				8%	16%			34%	33%			
	PM				35%	*13%*			2%	20%			
Third Avenue	AM	-92%	-52%			-68%	-67%				-59%	7%	0%
Pine St	MD	-9%	18%			4%	14%				20%	15%	17%
	PM	-85%	-62%			-64%	7%				-52%	18%	-45%
Third Avenue	AM	-85%	-58%	-50%		-82%	107%				-26%	-10%	12%
Stewart St	MD	-3%	-29%	-44%		-37%	29%				-28%	-28%	-70%
	PM	-90%	-65%	-59%		-81%	181%				-40%	-26%	-66%
Third Avenue	AM		-42%	58%	5%	-52%		-7%	13%	16%			
Virginia St	MD		9%	122%	-4%	2%		-13%	3%	11%			
	PM		-44%	15%	14%	-29%		3%	22%	-18%			
Third Avenue	AM	-23%	-52%			-40%	0%				14%	81%	-3%
Lenora St	MD	8%	-15%			-24%	-13%				-24%	-3%	-9%
	PM	-49%	-55%			-26%	65%				12%	98%	-6%
Second	AM					5%	47%				9%	-9%	
Lenora St	MD					-5%	-27%				3%	17%	
	PM					7%	20%				-2%	22%	
Second	AM					*14%*	21%				33%	10%	
Stewart St	MD					-6%	-24%				13%	6%	
	PM					-5%	-12%				36%	9%	
Second	AM					23%	50%				17%	-8%	
Pine St	MD					27%	-12%				12%	16%	
	PM					10%	-27%				9%	9%	
First Avenue	AM		45%	2%	-6%	14%		-10%	-5%	51%			
Spring St	MD		-6%	7%	16%	-10%		53%	12%	-6%			
	PM		32%	-30%	-45%	-26%		-11%	-7%	-33%			

Yellow highlighted > 100 vehicles per hour and >15% change
Blue highlighted *Italics*: >100 vehicles per hour and < 15% change
No highlight < 100 vehicles per hour change between pre- and post-tunnel closure

Emergency Vehicle Signal Priority Project

In addition to monitoring general purpose traffic operations, tunnel closure planning included funding for a new Emergency Vehicle Signal Priority Project within the Seattle Central Business District. This project was designed to mitigate potential impacts to the Seattle Fire Department response due to tunnel closure.

"Opticom" units have been installed at forty locations in the Seattle Central Business district to replace the older system of fire preemption. Under the old system, all the programmed signals on a corridor would change to either an all way red or hold in green for the fire response route for three minutes. This three minute period created congestion on the crossing streets to a corridor. This frequently led to motorist frustration and intersections becoming blocked by impatient drivers. The newly installed Opticom system is dynamic, with only the intersections that are within a few hundred feet of the approaching emergency vehicle going into their preemption intervals. This minimizes the number of streets and intersections that have to recover from a preempt. Once the emergency vehicle has passed out of the line of sight, the signal goes into its recovery phasing and resynchronization. This minimizes impacts to the crossing streets and restores the response corridor back into its normal pattern in a timely manner rather than a set interval of three minutes.

Additionally, the project installed cross town preemption that allows for improved response time from the waterfront fire station. No previous hardwired fire preempt system existed for this station.

Measure 3: Transit Ridership and Bus Volumes

Monitoring Objectives

The purpose of monitoring transit passenger and bus volumes is as follows:

- Provide data on bus volumes by street segment in downtown Seattle.
- Measure the average weekday PM peak hour and weekday passenger loads crossing the Seattle CBD north-south screen line.
- Provide data as available from Community Transit and Pierce Transit on average ridership crossing the north-south screen line during average PM peak hours and weekdays.
- Identify and analyze any substantive changes in ridership or bus volumes for before and after tunnel closure conditions.

Methodology

Bus volumes used for this analysis were extracted from HASTUS - the King County Metro scheduling system - using the February 2005 and September 2005 service changes. These counts include in service as well as out-of-service coaches. A projection of bus volumes on downtown streets for after tunnel closure was issued with Volume 1, the Baseline Report. These projected bus volumes will be compared with actual bus volumes from the September 2005 service change, inclusive of routing adjustments made mid-shakeup to alleviate problems on Stewart Street.

For passenger loads, the Automated Passenger Count (APC) system is the primary source for passenger data for Metro coaches. APC data is collected in a random sample during each signup, downloaded and processed monthly. This data is summarized in a final form at the end of each signup. Preliminary data, based on smaller samples, is available monthly. Metro driver count data is collected on an ad hoc basis when preliminary APC results indicate that observations of trips on a particular route will fall below an adequate sample. Ridership data on Community Transit and Pierce Transit service is generated by the monitor reports supplied by each of these agencies. The ridership data from Community Transit and Pierce Transit is available by signup at the aggregate level.

APC data, supplemented by driver counts and estimates for any non-APC observed trips, was used to estimate Metro ridership volumes crossing the screen line just south of University Street, by trip, for the spring 2004 and fall 2005 signups during the PM peak hour and the average weekday. The results have been summarized by street and by direction to compare ridership volumes and loads before and after tunnel closure.

Bus Volumes

The bus volumes that were projected for downtown street segments during tunnel closure, as shown in the Volume 1 Baseline report, are summarized in Figure 8A. The actual post tunnel bus volumes for downtown streets, including the routing changes that were made on Second Avenue and the mid-shakeup adjustments on Stewart Street are shown in Figure 8B.

Bus volumes in the CBD during the PM Peak are essentially the same for most links as projected. The PM Peak period used for determining transit volumes is 4:30-5:30 p.m. Slight variations in volumes are due to schedule adjustments that change a trip from being within or included or excluded from the measured peak hour. Substantive changes that resulted in changes in bus volumes were a relocation of approximately four trips from Second Avenue to Third Avenue, and the service adjustments on Stewart Street.

Figure 8A. PM Peak Hour Transit Volumes- Projected in September 2005 Baseline Report

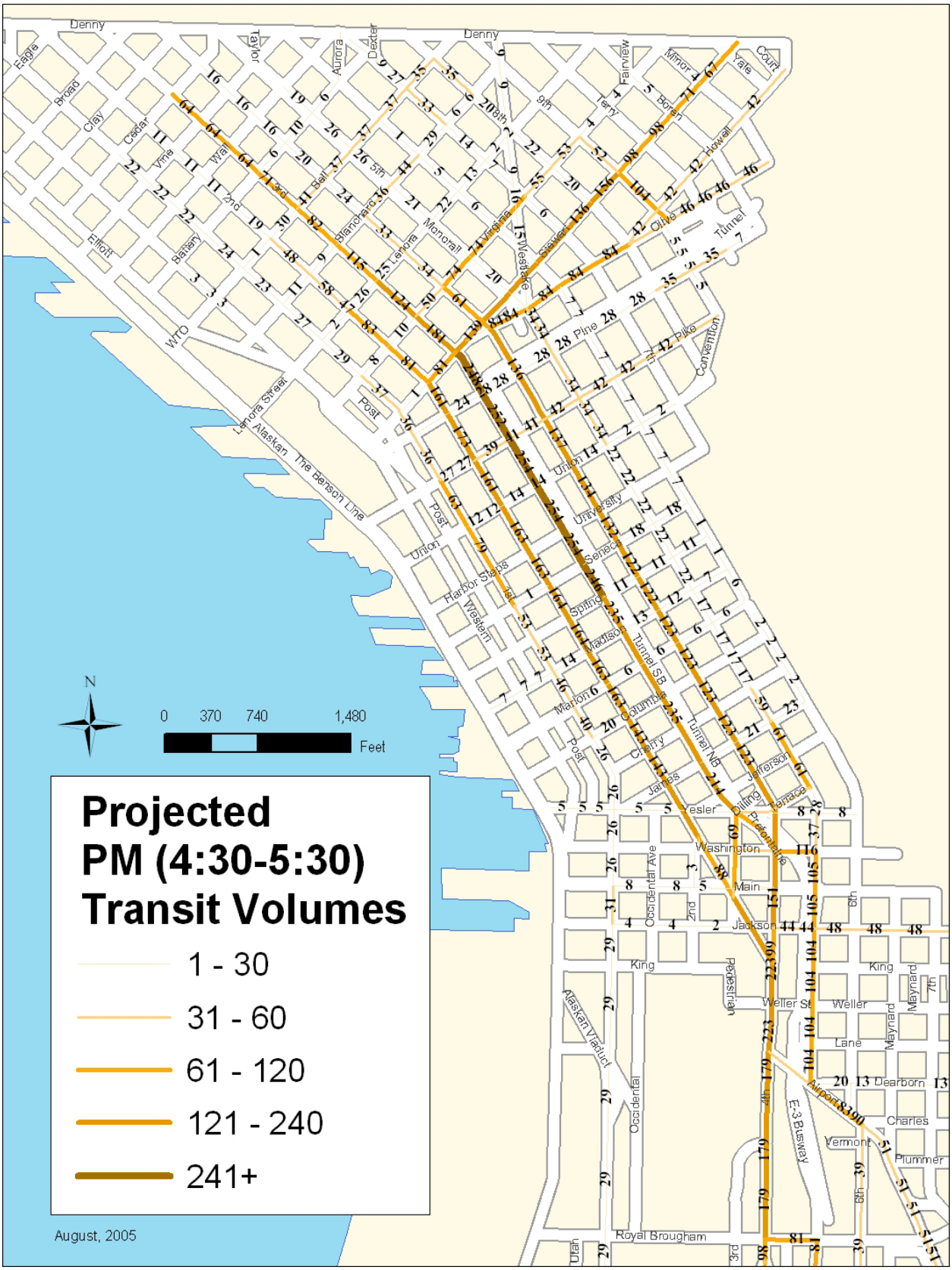
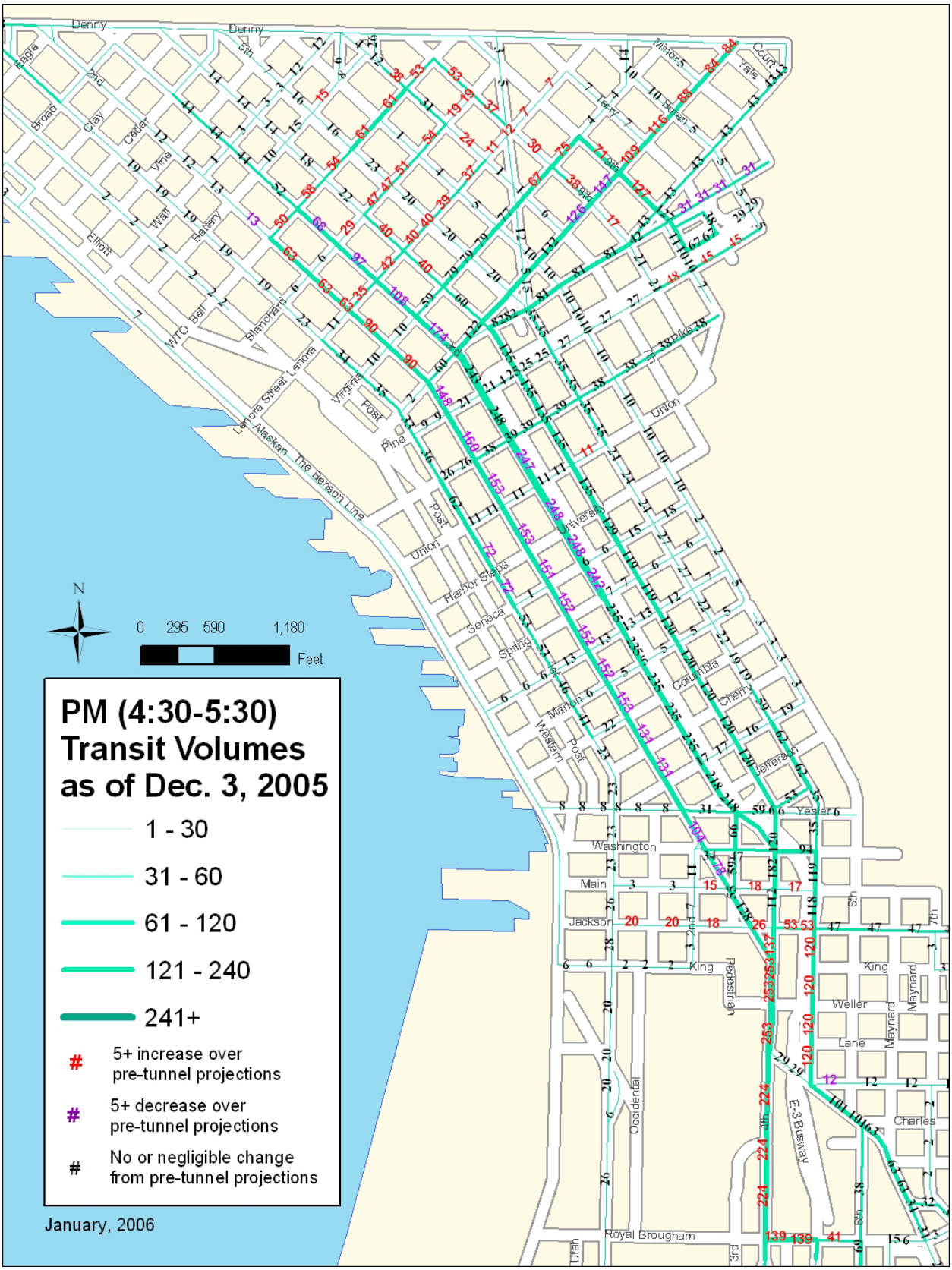


Figure 8B. PM Peak Hour Transit Volumes as of 12/03/05 (includes Stewart Adjustments)



Transit Ridership Volumes

Prior to tunnel closure, approximately 95,000 north-south riders crossed the downtown screen line on King County Metro-operated service at University Street on weekdays in fall 2004. As part of a general increase in ridership throughout the system, this number had increased to almost 106,700 weekday riders by the spring 2005. In fall 2005, ridership figures through November indicated that downtown loads crossing University Street had risen slightly higher, to 107,500. The final average for the entire fall 2005 signup is expected to be slightly lower, because ridership in December and January is typically lower than the counts for October and November. In addition, overall ridership on Community Transit-operated commuter services from downtown Seattle to Snohomish County increased by about 8.5 percent between May and October 2005. Ridership on Sound Transit commuter services from Pierce County as operated by Pierce Transit decreased by 4.9 percent but for the same period ridership on Sounder grew by 38.1 percent, for a net increase.

Given the general upward ridership trend, this report uses spring 2005 data for the before tunnel closure condition rather than fall 2004 to reflect the ridership growth that occurred prior to tunnel closure. Because Community Transit and Pierce Transit do not keep segment-level load statistics, the following discussion uses King County Metro data only.

Figure 9 compares the preliminary fall ridership at University Street on King County Metro-operated service with the baseline spring 2005 loads. Average weekday loads increased by slightly less than 1 percent. However, the total load crossing the screen line during the peak hour from 4:30-5:30 p.m. actually declined slightly.

Figure 9. Passenger Loads at University Street, before and after Tunnel Closure

		Weekday Riders		Percent Change	1-Hr PM Peak Riders		Percent Change
Avenue	Dir	Spring 2005	Fall 2005		Spring 2005	Fall 2005	
First	N	9,861	10,208	+3.5%	757	685	-9.5%
	S	6,002	6,484	+8.0%	469	597	+11.1%
Second	S	16,423	14,793	+8.3%	2,465	2,337	+9.4%
Third	N	17,849	28,380	+59.0%	1,478	2,741	+85.5%
	S	17,239	26,485	+53.6%	1,883	3,174	+68.6%
Fourth	N	10,375	15,368	+48.1%	825	1,023	+24.0%
Fifth	S	3,046	4,584	+50.5%	155	249	+60.6%
Tunnel	N	12,991	N.A.		1,188	N.A.	
	S	14,495	N.A.		1,959	N.A.	
Total		106,651	107,534	+0.8%	11,179	11,092	-0.8%

Figure 10 uses preliminary fall 2005 data to compare standing loads at University Street with the baseline spring 2005 standing loads. While the incidence of standing loads has increased, as expected, it is still well below the level of concern, especially given the preliminary nature of this data.

Figure 10. Loads over Seating Capacity at University Street, before and after Tunnel Closure

		Average Loads Greater than Seat Capacity				Average Loads 20% over Seating Capacity			
		Percent of Weekday Trips		Percent of Peak 1-Hr Trips		Percent of Weekday Trips		Percent of Peak 1-Hr Trips	
Avenue	Dir	Spring 05	Fall 05	Spring 05	Fall 05	Spring 05	Fall 05	Spring 05	Fall 05
First	N	1.8%	2.7%	7.5%	5.9%	0.0%	0.9%	0.0%	2.9%
	S	1.3%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Second	S	0.3%	0.5%	0.0%	0.9%	0.0%	0.4%	0.0%	0.9%
Third	N	1.2%	2.2%	1.5%	0.8%	0.2%	0.6%	0.0%	0.0%
	S	5.0%	5.4%	4.7%	7.7%	1.3%	1.6%	1.6%	1.9%
Fourth	N	0.5%	0.7%	0.0%	0.0%	0.3%	0.1%	0.0%	0.0%
Fifth	S	0.8%	0.3%	0.0%	0.0%	0.8%	0.3%	0.0%	0.0%
Tunnel	N	0.4%	N.A.	0.0%	N.A.	0.0%	N.A.	0.0%	N.A.
	S	0.2%	N.A.	0.0%	N.A.	0.0%	N.A.	0.0%	N.A.
Total		1.3%	2.3%	1.4%	2.4%	0.3%	0.7%	0.2%	0.8%

Preliminary fall data indicates that loads leaving the CBD are virtually the same as those leaving the CBD in spring 2005, about 90,800 riders each weekday. However, standing loads have increased, although they still represent a small fraction of all outbound trips. Figure 11 compares the percent of trips with standing loads leaving downtown at various times of the day. The largest increase, not surprisingly, is in the PM peak, when 6.4 percent of trips leaving the Seattle CBD had standing loads, as compared to 3.4 percent of trips in the spring. This increase was spread across a number of routes, including ones that would not be directly affected by tunnel closure.

Figure 11. Percent of Trips Leaving CBD Averaging Standing Loads, before and after Tunnel Closure.

		AM Peak	Midday	PM Peak	Evening	Total
		6-9 a.m.	9 a.m.–3 p.m.	3-7 p.m.	7-11p.m.	
Standing Loads	Spring 2005	2.4%	2.7%	3.4%	0.3%	2.4%
	Fall 2005	3.1%	4.1%	6.4%	0.8%	4.1%
Over 120% Load	Spring 2005	0.0%	0.7%	0.5%	0.0%	0.4%
	Fall 2005	1.1%	1.4%	1.2%	0.3%	1.0%

Measure 4: Pedestrian Activity at Bus Zones

Monitoring Objectives

The purpose of monitoring pedestrian activity at bus zones is to quantitatively assess pedestrian congestion at critical bus stops within the Seattle CBD. In particular, the study focuses on the impacts that transit tunnel closure had on pedestrian congestion at or near bus stops on surface streets. This portion of the study aims to answer the following key questions:

- How crowded are bus stops after tunnel closure?
- How easily can pedestrians flow through the bus stop area after tunnel closure?
- Does the tunnel closure have significant impacts on the pedestrian environment at or near bus stops?

Methodology

This study focused on two elements of pedestrian congestion: pedestrian crowding and pedestrian flow.

Pedestrian crowding is applicable to waiting and queuing areas, and is based on the average space available per person. The *Transit Cooperative Research Program (TCRP) Transit Capacity and Quality of Service Manual* specifies criteria for Level of Service (LOS) designations ranging from A to F for queuing and waiting areas (Part 7, Chapter 3). In addition to these national guidelines, Metro applied its own criteria to the amount of space available per person in bus stop waiting areas. Metro established these criteria because of the unique operating requirements and observed pedestrian behavior at bus stops within the Seattle CBD.

The criteria for pedestrian crowding are shown in Figure 12. For each bus stop, the LOS for standing pedestrians will be reported separately for both the full bus zone waiting area, and for the critical loading area defined as the space within 100 feet behind the head of the bus stop.

Figure 12. National and King County Metro criteria for Standing Pedestrian Level of Service (LOS)

HCM Criteria	ft^2/ped
LOS A	> 13
LOS B	10 -13
LOS C	6 - 10
LOS D	3 - 6
LOS E	2 - 3
LOS F	< 2

KCM Criteria	ft^2/ped
Desirable	>17
Constrained	17 - 8
Uncomfortable	< 8

Pedestrian flow is applicable to the movement through the bus zone and is based on the number of pedestrians passing per minute passing through a walkway of limited width. The *2000 Highway Capacity Manual* specifies criteria for LOS designations of A through F for walkways. In addition to these criteria, pedestrian level of service will be further evaluated using procedures outlined in *Urban Spaces for Pedestrians* by Pushkarev and Zupan (1975), Figure 13 shows how these criteria relate to the number of pedestrians passing per minute through and area of unit width.

Figure 13. Criteria used for Walking Pedestrian Level of Service (LOS)

HCM Criteria	pedestrians/feet/ minute
LOS A	< 5
LOS B	5 - 7
LOS C	7 - 10
LOS D	10 - 15
LOS E	15 - 23
LOS F	>23

Pushkarev & Zupan Criteria	pedestrians/feet/ minute
Open	< 0.5
Unimpeded	0.5 - 2
Impeded	2 - 6
Constrained	6 - 10
Crowded	10 - 14
Congested	14 - 18

To measure the pre-tunnel closure conditions, an initial pedestrian congestion study was conducted at 19 selected bus zones in spring of 2005[1]. For the subsequent after-tunnel closure study, conducted in fall 2005, six additional bus zones were added to the study, including newly installed zones, bringing the total number of zones counted to 25.

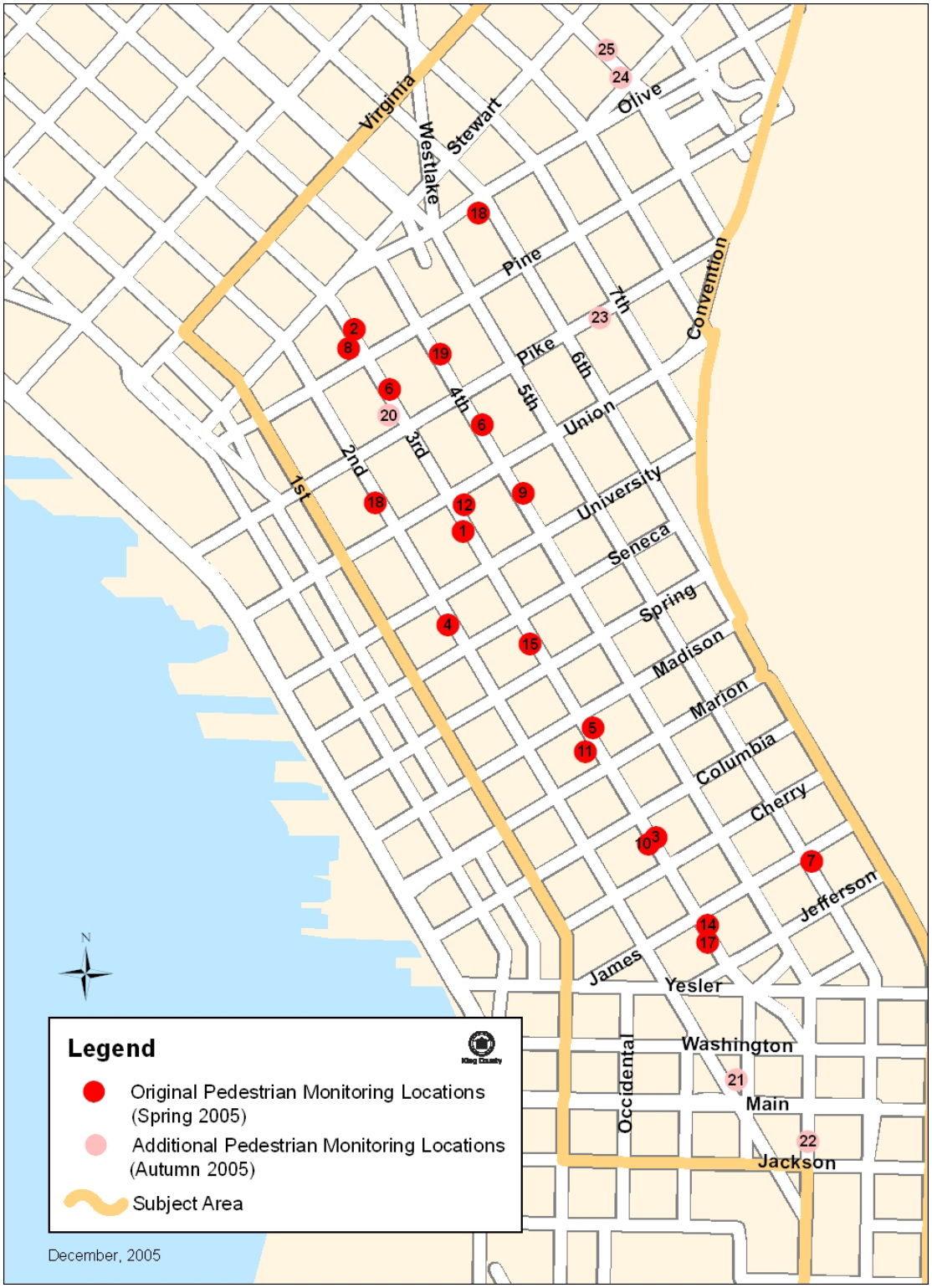
Each bus stop was observed for two days, during a two-hour period within the PM peak (3-7 p.m.) only. Data collection was done only on a Tuesday, Wednesday, or Thursday, between the dates of 10-04-2005 and 10-20-2005. Some data collectors counted the number of people waiting within the pre-defined waiting areas, and were responsible for taking a count every two to five minutes at the bus stop. Other data collectors continuously observed each bus stop, counting the number of people walking through the bus stop area in two to five minute intervals. In addition, staff noted the amount of sidewalk width available for pedestrians walking through the bus zone, since waiting passengers can reduce the amount of available width.

Additional pedestrian counts may be collected to assess follow-up efforts and to measure conditions after the tunnel is re-opened. The summary discussion at the end of this section provides some recommendations for a follow-up study.

Figure 14 shows the 25 bus stops that were surveyed in the fall 2005 post tunnel closure study.

[1] Pedestrian Congestion Study, Existing Conditions Analysis. 7-18-2005

Figure 14. Bus Stops Surveyed for Pedestrian Congestion Counts



Comparisons with Pre-Tunnel Closure Conditions

Figure 15 summarizes the results of the before-closure and after-closure studies as they relate to pedestrians walking through the bus zones. Figure 16 summarizes the results of the before-closure and after-closure studies as they relate to pedestrians waiting at the bus stops. In both figures, hot spot locations are identified with light shading. These hot spot locations are discussed in more detail in the next subsection.

Figure 15. Walking Pedestrian Rank and Level of Service by Bus Stop
(Map ID# corresponds to locations shown on Figure 14)

Location				Spring 2005 (before closure)		Autumn 2005 (after closure)	
Map ID #	Bus Stop #	Dir	On-street/Cross-street	Pushkarev & Zupan Rank	HCM LOS	Pushkarev & Zupan Rank	HCM LOS
1	450	SB	Third Ave./Union St.	Unimpeded	A	Unimpeded	A
2	590	NB	Third Ave./Pine St.	Unimpeded	A	Impeded	A
3	538	NB	Third Ave./Columbia St.	Unimpeded	A	Impeded	A
4	315	SB	Second Ave./University St.	Impeded	A	Impeded	A
5	548	NB	Third Ave./Madison St.	Unimpeded	A	Unimpeded	A
6	690	NB	Fourth Ave./Union St.	Impeded	A	Constrained	C
7	860	NB	Fifth Ave./James St.	Impeded	A	Impeded	A
8	430	SB	Third Ave./Pine St.	Impeded	A	Impeded	A
9	682	NB	Fourth Ave./University St.	Unimpeded	A	Impeded	A
10	490	SB	Third Ave./Columbia St.	Unimpeded	A	Impeded	A
11	531	NB	Third Ave./James St.	Unimpeded	A	Impeded	A
12	570	NB	Third Ave./Union St.	Impeded	A	Impeded	A
13	1040	EB	Olive Way/Sixth Ave.	Impeded	A	Constrained	C
14	480	SB	Third Ave./Marion St.	Unimpeded	A	Impeded	A
15	468	SB	Third Ave./Seneca St.	Impeded	A	Impeded	A
16	578	NB	Third Ave./Pike St.	Impeded	A	Impeded	A
17	500	SB	Third Ave./James St.	Unimpeded	A	Unimpeded	A
18	300	SB	Second Ave./Pike St.	Impeded	A	Impeded	A
19	700	NB	Fourth Ave./Pike St.	Unimpeded	A	Impeded	A
20	431	SB	Third Ave./Pike St.	[not counted]		Impeded	A
21	515	SB	Third Ave/Main St.	[not counted]		Unimpeded	A
22	619	NB	Fourth Ave./Jackson St. (Island)	[not counted]		NA	NA
23	1191	EB	Pike St./Sixth Ave.	[not counted]		Impeded	A
24	1913	SB	Ninth Ave./Howell St.	[not counted]		Impeded	A
25	1917	NB	Ninth Ave./Howell St.	[not counted]		Impeded	A

Most of the sidewalk segments within the bus stop zones currently operate at a high level of service, LOS A as measured by the HCM method, during the evening peak 15 minutes. However, two of the sidewalk segments have degraded to LOS C after the tunnel closure. A greater number of zones now operate with 'impeded' conditions according to the Pushkarev and Zupan ranking, which is a more stringent standard. The worsening of level-of-service in these cases is due to a combination of higher volumes of people walking on the sidewalks, and narrower effective widths available for walking due to some constriction.

Figure 16. Standing Pedestrian Level of Service for Full Bus Stop Area and Critical Loading Zone
(Map ID# corresponds to locations shown on Figure 14)

Location			Spring 2005 (before closure)				Autumn 2005 (after closure)			
			Full Zone		Critical Zone		Full Zone		Critical Zone	
Map ID #	Bus Stop #	On-street/Cross Street	HCM LOS	King County Rank	HCM LOS	King County Rank	HCM LOS	King County Rank	HCM LOS	King County Rank
1	450	Third Ave./Union St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
2	590	Third Ave./Pine St.	A	Desirable	A	Desirable	A	Constrained	A	Constrained
3	538	Third Ave./Columbia St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
4	315	Second Ave./University St.	A	Desirable	A	Constrained	A	Desirable	B	Constrained
5	548	Third Ave./Madison St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
6	690	Fourth Ave./Union St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
7	860	Fifth Ave./James St.	A	Desirable	B	Constrained	B	Constrained	C	Uncomfortable
8	430	Third Ave./Pine St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
9	682	Fourth Ave./University St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
10	490	Third Ave./Columbia St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
11	531	Third Ave./James St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
12	570	Third Ave./Union St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
13	1040	Olive Way/Sixth Ave.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
14	480	Third Ave./Marion St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
15	468	Third Ave./Seneca St.	A	Desirable	A	Desirable	A	Desirable	A	Constrained
16	578	Third Ave./Pike St.	A	Desirable	A	Desirable	A	Desirable	A	Constrained
17	500	Third Ave./James St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
18	300	Second Ave./Pike St.	A	Desirable	A	Constrained	A	Desirable	B	Constrained
19	700	Fourth Ave./Pike St.	A	Desirable	A	Desirable	A	Desirable	A	Desirable
20	431	Third Ave./Pike St.	[not counted]				A	Desirable	A	Desirable
21	515	Third Ave/Main St.	[not counted]				A	Desirable	A	Desirable
22	619	Fourth Ave./Jackson St. (Island)	[not counted]				A	Desirable	A	Constrained
23	1191	Pike St./Sixth Ave.	[not counted]				A	Desirable	A	Desirable
24	1913	Ninth Ave./Howell St.	[not counted]				A	Desirable	A	Desirable
25	1917	Ninth Ave./Howell St.	[not counted]				A	Desirable	A	Desirable

During the PM peak period, most of the bus zones included in this study still operate at a high level of service, LOS A, as defined by the nationally accepted guidelines in the Highway Capacity Manual, and considering the entire bus zone waiting area. However, one full bus zone, NB Fifth Avenue at James Street has degraded to LOS B since tunnel closure.

Using a more stringent methodology developed by King County, the critical loading areas for seven of the bus zones experience some constraints or uncomfortable crowding. These degradations in levels-of-service are largely due to an increase in the number of people waiting at a bus stop at one time.

Summary Observations

Based on the findings of the after-tunnel closure pedestrian congestion study, six hot spot locations were identified and further evaluated. The hotspots were defined as locations exhibiting at least one of the following: 'Constrained' walking conditions, 'constrained' waiting conditions in the full bus zone area, or HCM LOS B or worse conditions in the critical loading zone.

- **Zone 860 (NB Fifth Ave & James St):** Constrained waiting conditions and uncomfortable crowding in the critical loading area were observed. The excessive crowding has been attributed to the narrow sidewalk, and also due to service delays which increase the number of waiting passengers. Many transit routes that serve this bus zone originate in the north CBD area, and these buses were caught in delays on Stewart Street. Since the study was conducted in the first few weeks of tunnel closure, service reliability has improved. A follow-up study is recommended for this location to assess the impacts of a set of improvements on Stewart that will be fully implemented by January, 2006.
- **Zone 690 (NB Fourth Ave & Union St):** Constrained walking conditions were observed, this was attributed to the temporary construction fencing obstructing the sidewalk. The fencing has since been removed. Re-evaluating this bus zone with the new sidewalk width is recommended, but a re-count is not needed.
- **Zone 1040 (EB Olive Way & Sixth Ave):** Constrained walking conditions were observed, attributed to a narrow sidewalk and street furniture. The placement of street furniture was re-evaluated, but few opportunities were found for improvement. A follow up study is not recommended at this location, as conditions are not expected to change.
- **Zone 315 (SB Second Ave & University St):** Constrained waiting conditions in the critical loading area were observed, although the total bus zone area operated with desirable waiting conditions. To help improve pedestrian circulation around the zone, bus shelter side-panels have been removed. A follow up study is recommended to measure the effectiveness of this measure.
- **Zone 300 (SB Second Ave & Pike St**): Conditions similar to the bus zone at Second Avenue and University were observed at this location. A possible mitigation measure that could be taken is to remove the rear panels and benches of some of the bus shelters, to improve pedestrian circulation around the bus zone. The pedestrian crowding observed during the study may also be partly attributable to delays on Stewart Street, so it is recommended that no action be taken at this time. A follow-up study is recommended for this location.
- **Zone 590 (NB Third Ave & Pine St):** Constrained waiting conditions were recorded for the full bus zone area as initially defined. However, the bus zone waiting area defined for this stop did not include the area adjacent to the Macy's loading dock, to the north of the bus zone. During the survey, surveyors observed that transit passengers used this area during busy conditions. Since the zone functionally includes this area, a follow-up count is recommended to capture these additional waiting passengers and to then re-compute the level of service using the larger effective waiting area.

Measure 5: Seattle Central Business District (CBD) Customer Surveys

Monitoring Objectives

- Formally assess downtown user perceptions, behavior and satisfaction levels before and during tunnel closure and after the tunnel reopens to transit use in order to assess the effectiveness of the mitigation measures sponsored by the interagency Monitor and Maintain (M & M) team.
- Collect informal feedback from downtown user after tunnel closure to better understand if the mitigation efforts are working well or poorly and to identify key areas for immediate improvement or fine-tuning.

Methodology

There are two survey instruments that are being employed to gauge the public reaction to tunnel closure.

The first instrument is a formal survey employing the services of a full service research consultant who will survey randomly selected cluster samples downtown of groups targeted for the survey. The type of information collected from bus riders is as follows: purpose of downtown travel; frequency of downtown travel and changes in that frequency; changes in using the bus to travel downtown; overall impression of downtown Seattle; and transit rider satisfaction or dissatisfaction with a number of factors such as travel time by bus through downtown, personal space when waiting at stops, time between buses, on-time performance of buses, location of stops predictability of bus arrivals and departures, and personal security waiting for buses when dark and during the day.

The kinds of information to be reported for drivers to downtown include: purpose of downtown travel; frequency of downtown travel and changes in that frequency; changes in using a car to travel to downtown; overall impression of downtown Seattle; and driver satisfaction or dissatisfaction with travel time through downtown by car, convenience of routes through downtown by car, clarity of information (signage, rules) for drivers downtown, ability to park downtown, convenience of parking to destination, and cost of parking

Information from both drivers and transit users will be collected to learn about their general satisfaction or dissatisfaction with the following: being able to walk around downtown without feeling crowded; personal security when walking around downtown; adequacy/clarity of information given to downtown users about the tunnel project; things that are working well and working poorly; performance of those responsible for helping ease disruptions; and recommendations for needed changes or adjustments. Approximately 1,000 downtown users will be surveyed with each formal survey. The survey itself will require 10-15 minutes to complete.

A “before” survey was conducted in spring 2005. The results of this “before” survey were reported in the Volume 1 Baseline Report that was issued in September 2005. These results will be updated with two more formal surveys, one to be conducted during tunnel closure in the summer of 2006 and another to be conducted after the tunnel reopens to transit travel in the summer of 2008. Readers are referred to *Volume 1: Baseline Conditions* for the complete discussion of this “before” survey. However, one of the main conclusions for this survey was that the respondents generally had a positive impression of the downtown, that they did not feel crowded when moving around downtown and that they were satisfied with their personal security and safety

The second instrument that will be used to gauge pubic opinion about tunnel closure will be smaller intercept surveys on a sample of approximately 200 to 300 downtown users. This intercept survey will provide some early feedback on what downtown constituents are feeling about tunnel closure. Given the difference in methodology and sample size, it should be emphasized that the results of the quick feedback survey cannot be compared with the results of the more formal customer survey of downtown users described above. They should be viewed as providing information that is similar to the type of information that can be gotten from small focus groups.

The first small scale intercept survey was conducted in fall 2005 immediately following tunnel closure. Participants were recruited at selected bus stops, and along key downtown streets affected by tunnel closure to participate in this survey. The consultant solicited names and telephone numbers from downtown users and then telephoned them for a short 10 minute survey. This informal sample of downtown users was put together during the PM period (2-6 p.m.) for the fall 2005 quick feedback survey. The survey collected their opinions about what is working well or poorly in following areas: getting to and through downtown; assessment of crowding on streets and sidewalks; clarity of signage and information being provided about tunnel closure; changes to bus service and car routing that were done in response to tunnel closure; and other information/opinions they may choose to offer. Respondents were also asked for their recommendations on how things could be improved. These types of surveys can provide a general sense for how downtown users are being impacted by tunnel closure. While not statistically valid, like focus groups, inferences can be drawn.

In addition to the quick feedback survey that was completed in fall 2005, two more quick feedback surveys will be conducted, one in the spring of 2006 and the second in the spring of 2007.

Summary Observations from the Informal Intercept Survey, Fall 2005

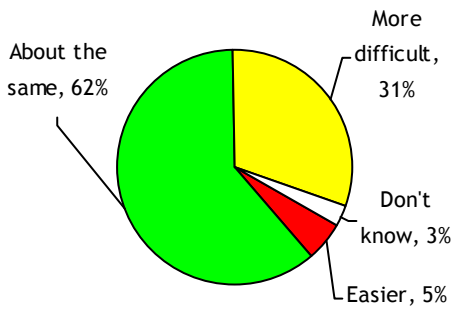
While a majority of respondents felt it was not more difficult to get to downtown, that their buses were on time and that the convenience of their bus stop locations has not changed, a sizable minority of respondents believe these travel elements had gotten worse since the tunnel closed. Respondents were evenly divided on whether it now takes more time to get through downtown and whether downtown is more crowded than before the tunnel closure.

Most respondents (62 percent) think getting to downtown is about the same as it was before the tunnel closed, but nearly one in three respondents (31 percent) said getting downtown is more difficult than it used to be (Figure 17).

The survey findings also clearly demonstrate the success of efforts to provide information about tunnel closure to those traveling to and from downtown Seattle. The vast majority of respondents (93 percent) said they knew about the tunnel closure before it happened.

Figure 17.
Ease of Traveling to Downtown Before & After Tunnel Closure
All respondents

(Base = 329)



Question 12A: Comparing downtown now to before the tunnel closure, would you say getting to downtown is easier, about the same, or more difficult?

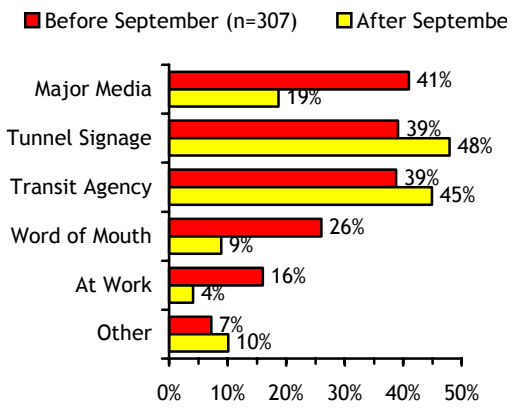
"Don't know" responses not shown.

Most respondents (52 percent) learned of the tunnel closure from more than one source. The most popular information sources were major media such as newspaper, television and radio (41 percent) followed by tunnel signage at the bus tunnel and on downtown streets (39 percent) and information from transit agencies such as signs posted at bus stops, brochures, rider alerts, etc. (39 percent). Figure 18 shows the main information sources respondents used.

Respondents who reported seeing information about the tunnel closure after September 24, 2005 were asked to rate the information they received. As Figure 19 shows, six in ten respondents (61 percent) found the information very informative and an additional 34 percent said it was somewhat informative.

Respondents who received information from a transit website or transit timetables were the most likely to say the information they received was very informative (92 percent and 100 percent respectively). The radio and newspaper articles were also valued information sources with 86 percent and 76 percent respectively rating these sources as very informative.

Figure 18.
Tunnel Closure Information Sources
Respondents who heard about the tunnel closure
(Bases listed below)



Question 6: Where did you see that information (before tunnel closed)?

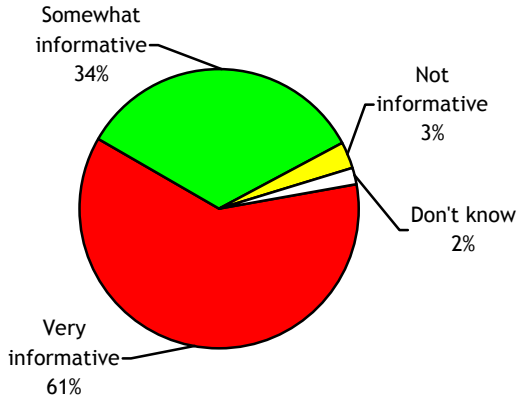
Question 7: Since September 24, where have you seen information about the tunnel closure?

Multiple responses accepted.

Figure 19. How Informative Was the Information Received

Respondents who saw information about the tunnel closure after September 24, 2005

(Base = 286)

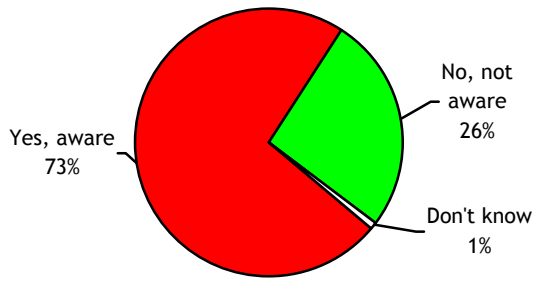


Question 8: **How would you rate the level of information you received? Would you say it was very informative, somewhat informative or not informative?**

May not sum to 100% due to rounding.

Figure 20.
Awareness of Joint Efforts to Minimize Traffic Impacts
All respondents

(Base = 329)



Question 9: Are you aware that the City of Seattle, King County Metro, Sound Transit and Community Transit have been working together to minimize the impacts of the tunnel closure and keep downtown Seattle open and accessible?

May not sum to 100% due to rounding.

Figure 21.
Suggestions for Improving Downtown Seattle
All Respondents

(Base)	**Total (329)**
Bus Service Issues (Net)	**40%**
Buses too crowded/need more or bigger buses	14
Buses come late/early	6
Run buses more often	6
Change bus route and/or stop location	4
Too many/too few bus stops	4
Bus stops not covered/Shelters in wrong place	3
Bus stops are confusing/hard to find right bus	3
Better bus connections/difficult to transfer	2
Provide assistance to find right bus/bus stop	2
Buses bunch up/need to space out bus runs	2
Traffic Flow (Net)	**16%**
Close Third Avenue to traffic/Make Third transit only	6
Reopen the tunnel	3
Direct downtown traffic/Improve traffic flow	3
Increase transit use/decrease driving	2
More bus only streets/lanes	2
Light Rail (Net)	**3%**
Light rail is a good idea/support light rail	3
Light rail is a bad idea/oppose light rail	<1
Information (Net)	**3%**
Better/more signage	2
Better/more information on website	1
Increase Security/Address Panhandling	**4%**
Other	**12%**

Question 19: The transit and government agencies are very interested in hearing suggestions from people who come downtown. What specific recommendations for improvements can you suggest?

Multiple responses accepted.

Nearly three in four respondents (73 percent) said they were aware of the joint efforts of transit agencies and the City of Seattle to minimize the impacts of the tunnel closure (Figure 20). Bus riders were more likely to be aware of the joint effort than car travelers (75 percent versus 52 percent)

Bus riders who said it takes longer to get through downtown since the tunnel closed were asked to identify the locations where vehicle traffic is the most difficult. Responses were tallied based on the number of times each street was mentioned. The streets most commonly mentioned as problem areas were: Third Avenue, Stewart Street, Second Avenue, Fourth Avenue, Fifth Avenue, and Pike Street. A complete list of street names by descending order of mention is shown in Figure 22. A hand tally of specific intersections mentioned found that the most commonly mentioned intersections were:

- Third Avenue and Pike Street (6 mentions)
- Fifth Avenue and Stewart (4 mentions)
- Third Avenue and Stewart (3 mentions)

Perceptions of how easy or difficult it is for people to travel to and through downtown Seattle since the tunnel closure are mixed. Respondents were asked what suggestions they had for improving downtown Seattle. As Figure 21 shows, most responses related either to bus service (40 percent) or traffic flow (16 percent).

Figure 22.
Downtown Locations Where Vehicle Traffic is Difficult

Bus riders who said travel time through downtown is worse than before tunnel closure

Street Name (Base)	% (119)	Street Name (Base)	% (119)
Third Avenue	35%	Getting on/off freeway	3%
Stewart	23	Seventh Avenue	3
Second Avenue	18	Near King St. Station	3
Fourth Avenue	12	Madison	3
Fifth Avenue	10	Seneca	2
Pike	10	Chinatown	2
Pine	7	Columbia	2
Union	7	James	1
First Avenue	5	Rainier Avenue	1
Ninth Avenue	4	Washington	1
Downtown (general)	4	Olive Way	1
Jackson	3	Other	10
Virginia	3	Don't know	9

Question 16B: At what locations does the vehicle traffic seem to be the most difficult?
Multiple responses accepted.

Measure 6: Transportation Demand Management Program

Goals and Objectives

The Transportation Demand Management (TDM) program was designed to retain and increase users of alternative modes of transportation (transit, walking, bicycling, rideshare) during the Downtown Seattle Transit Tunnel closure period. Programs were developed that targeted commuters working within the Seattle Central Business District (CDB) and the International District.* A three-pronged approach was undertaken to achieve this goal:

- Enhancement of programs and products to retain existing users
- Broadening the scope of programs and products to attract new users (individuals and small employers)
- Creating a supportive operating environment necessary to promote alternative modes of transportation

** Commuters must work within the following downtown boundary to participate: south of Stewart Street, north of Dearborn Street, west of I-5, and east of Elliot Bay.*

Data Collection

Each TDM program has been monitored and tracked using relevant statistics to determine its attractiveness and effectiveness. The data is being collected on a month-to-month basis and will be reported through the Monitor and Maintain Committee periodically until the reopening of the tunnel in September 2007. Volume 2 includes data on the TDM programs for the four month period of August through November in order to account for the pre-tunnel launches of many of these programs as planned mitigation measures. See Figure 23 for a comparison of pre-tunnel closure participation of each of the fifteen TDM programs, with participation levels post tunnel closure through November 2006.

Figure 23. First Reporting Period Data (August – November)

Existing Programs with Enhancements	**Baseline Numbers (April 2005)**	**# of New Participants (Aug - Nov)**	**Total**
Puget Pass Consignment			
# of Accounts	67^	2	69
# of Passes	4,141^	805	4,946
FlexPass			
# of Contracts*	129	30	159
# of Passes	8,330	1,129	9,459
Rideshare (Carpool, Vanpool, VanShare)			
# of Accounts**	59	12	71
# of Users*** (riders)	448	50	498
Rideshare Online			
# of Registrants	450	501	951
Flexcar			
# of contracts****	4,523	223	4,746
New Programs to Increase and Retain Users of Alternative Travel Modes	**Baseline Numbers (April 2005)**	**# of New Participants (Aug - Nov)**	**Total**
Home Free Guarantee (HFG) for Individuals			
# of Accounts	N/A	219	219
# of Rides (usage)	N/A	3	3
Plan Your Commute			
# of Participants	N/A	1,218	1,218
Telecommuting			
# of Workshops	2	1	3
Percent of companies that allow telework	10%	22%	22%
New Programs to Support the Operating Environment of Alternative Modes	**Baseline Numbers (April 2005)**	**# of New Participants (Aug - Nov)**	**Total**
Bicycling			
# of Workshop Participants	N/A	16	16
Shop Dine & Ride			
# of Retail Participants	N/A	88	88

^ - Puget Pass Consignment baseline numbers from June 2005
* - FlexPass and FlexPass + CT added together
** - Rideshare totals (accounts and users) from STAR Carpools, Metro Vanpools, Community Transit Vanpools, other Vanpools, and Metro VanShare. Carpools do not include City of Seattle registrations.
*** - Estimates based on 7 riders per Community Transit vanpool
**** - Both Flexcar business contracts and individual members added together

Program Notes

Puget Pass Consignment

Two new Puget Pass Consignment accounts, representing 805 new employee passes have been executed. There are now a total of 69 Puget Pass Consignment accounts representing 4,946 employee passes. Eleven of these consignment accounts have chosen to take advantage of the enhanced Home Free Guarantee Consignment program, which provides HFG as a free benefit to their employees. Only three free rides have been utilized.

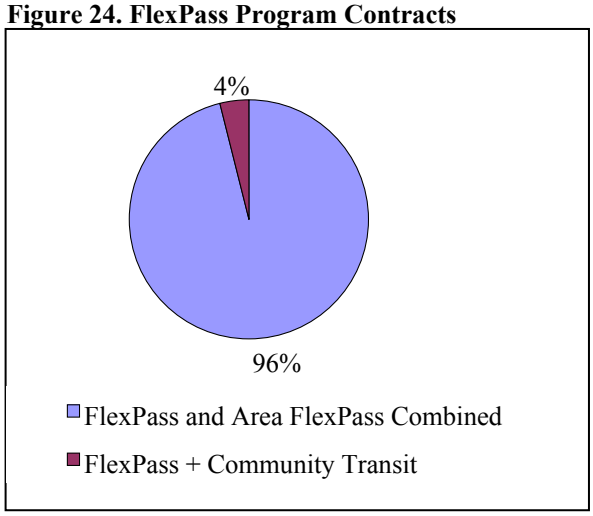
FlexPass

Thirty new FlexPass accounts representing 1,129 passes have been executed during the reporting period. This makes the total number of downtown FlexPass accounts 159, representing 9,459 passes. Six of those contracts include Community Transit services for a total of 1,622 passes.

Rideshare

The number of vanpools and users to the Central Business District (CBD) has increased within the first reporting period, with six new vanpools (four Metro and two Community Transit) for an approximate total of 41 riders. Six new carpools have registered in the Urban Mobility Group's STAR program.

Figure 24. FlexPass Program Contracts



Flexcar

Flexcar is offering Flexbuck usage vouchers for FlexPass or PugetPass holders. Since August 1, 2005, seven new businesses and 216 individuals have signed up for the program, and 10 of the 230 distributed Flexbuck vouchers have been redeemed.

Home Free Guarantee (HFG) for Individuals

Monthly Puget Pass holders who work in downtown are eligible for Metro's HFG program at no cost. Of the 219 travelers that have signed up since the start of the program, three free rides home have been utilized.

Plan Your Commute (PYC)

Within a short time span, from the week before the closure of the Downtown Seattle Transit Tunnel until the last week in October, 1,196 participants learned about commute options from personal rider information officers at mobile Plan Your Commute stations. Over 21,000 King County Metro free ride tickets were distributed, with 34 percent redeemed as of the end of December 2005. 4,970 Sound Transit and 480 Community Transit free ride tickets were distributed through the end of December. This new program is continuing on a weekly basis at the Transportation Connection every Wednesday from 11:30 a.m.-1:30 p.m..

Telecommute

Fifteen individuals attended a telecommute workshop in October. The estimated rate of total companies in the CBD that allow for telecommuting increased from 10 percent to 22 percent since the closure of the tunnel.

Bicycling

There have been a total of 16 bike commuters who work downtown that have completed the four-hour bicycle commute skills workshop. There are currently three downtown Seattle locations offering stand-alone shower-memberships with potential. Bicycle parking is being offered in public areas, private/controlled access areas, and public access on private property areas.

Shopper Incentives

Eighty-eight retail /service providers participated in the first phase of the Shop, Dine and Ride program which encourages commuters and shoppers to continue to visit downtown Seattle throughout the tunnel closure period. 50,000 brochures were printed and distributed at transit information racks, Metro pass sales outlets and select merchants, Approximately 5,000 program bookmarks touting www.shopdineride.org were distributed through the Plan Your Commute sessions, community events and other venues. An electronic guide is available at www.shopdineride.org, which also features program updates and new coupons. New editions will be published twice yearly through 2007. The second edition of the guide will be rolled out in early February 2006 and has added approximately forty new merchants and in addition to previous distribution, the Seattle Times will be passing out guides in Downtown Seattle for the first several weeks of February.

Summary Results from TDM Program

The package of TDM programs introduced in support of tunnel closure has successfully expanded participation in commute options. Some highlights include:

- Thirty new FlexPass contracts representing 1,129 passes have been executed. Of these, 749 passes include Community Transit – a new option for Area FlexPass participants available only during tunnel closure.
- The percentage of Downtown Seattle employers that offer telecommuting has increased from 10 percent to 22 percent.
- The Plan Your Commute program has helped over 1,100 commuters explore alternative travel options.
- Over 200 Puget Pass holders signed up for the Home Free Guarantee for Individuals program.
- Registration activity at Rideshare Online has increased with more than 500 registrations during this reporting period.
- Forty new merchants have been added to the second edition of the successful Shop, Dine and Ride Program Guide that will be issued in February 2006.